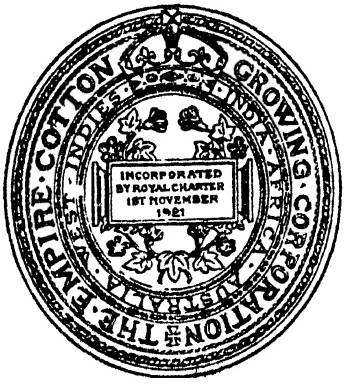
INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

I. A. R. I. 6.
MGIPC—S1—6 AR/54—7-7-54—10,000.

The Empire Cotton Growing Review

Journal of the Empire Cotton Growing Corporation



Vol. X. 1933

Edited by
J. C. WILLIS, M.A., SC.D., F.R.S

Published by
P. S. King & Son, Ltd., 14, Great Smith St., London, S.W. 1
for the Empire Cotton Growing Corporation

Quarterly: Price 1s.
Annual Subscription, 5s. post free

THE
EMPIRE COTTON GROWING
REVIEW

VOL. X. JANUARY, 1933. NO. 1

MIXED FARMING AND COTTON PRODUCTION IN NORTHERN NIGERIA

BY

O. T. FAULKNER,

Director of Agriculture, Nigeria.

THE history of cotton exports from Nigeria in recent years makes depressing reading:

Year.	*Bales Exported.*	*Price per Pound of Seed Cotton (Pence).*	*Yield of Seven Alternate Plots A1–13 at Samaru (Pounds per Acre).*
1924–5 ..	28,000	3·0	—
1925–6 ..	37,000	2·5	483
1926–7 ..	17,000	1·5	439
1927–8 ..	16,000	2·3	431
1928–9 ..	25,000	2·2	314 + 19
1929–30 ..	34,000	1·4	245 + 59
1930–31 ..	14,000	0·6	178 + 77
1931–32 ..	4,500	0·7	215 + 59

But Northern Nigeria is fortunate in possessing another market for its cotton, in the local hand-weaving industries, especially of Kano and across the northern border. There is a considerable area of cotton grown every year in the Kano province, and when the export price is high a little seed cotton is actually exported from Kano; but last year there was a very considerable movement of seed cotton northward from the main cotton-growing districts of the Zaria province, Southern Katsina, and Eastern Sokoto; and a distinctly higher price was paid for seed cotton for this purpose than the exporters could offer. The variability of the export thus becomes much greater than that of the total production; but the farmer receives valuable help in seasons when the price of cotton for export is low.

The figures in the last column give the average yield of a series of seven plots, first cultivated in 1924, on which cotton has been grown annually since 1925 without manure. The figures following the plus sign show the average increase in yield on the six alternating plots (A2-A12), which have received an application of one ton of farmyard manure per acre each year since 1928. There is naturally a progressive decrease during the first four or five years as the virgin soil deteriorated. The figures suggest that the variations of the export are not, in the main, due to the variations of the yield per acre of the cotton fields. Such a statement could not, of course, justifiably be based on the yield of one field; but it is supported by considerable evidence, which these figures serve to illustrate.

The price paid for seed cotton by exporters naturally fluctuates a little even during the short annual buying season, and the price quoted in the table above is that which prevailed at the most important part of each season. These figures evidently offer a more feasible explanation of the variations in export. If the price rises, or even remains steady for two or three years, the export rises: a low price in any season results in a small export in that season (the balance of the production being absorbed by the hand industry), and also in the planting of a lesser area in the next season. There is reason to believe that farmers will react to changes in the prices of products even more quickly in the future than in the past.

It should, however, be mentioned that the exceptionally small export in 1931-2 was due more to the indirect effects of the plague of locusts of 1930 than to the price of cotton. In 1930 locusts damaged the corn crop of the country to an extent which, while not sufficient to cause an actual shortage of food, was yet great enough to make the price of corn rise unusually high. The people, influenced by their memories and traditions of former infestations, anticipated that in 1931 the damage would be very much greater, and the price of corn in 1932 consequently still higher. At the expense of cotton a greater area of corn was planted, and also of foods like cassava, which the locust does not damage. The year 1931 was a favourable one for grain, and the destruction of locust hoppers was so effective that the damage done by locusts was quite unimportant. Thus, after that harvest, grain became cheaper than it had been for many years, and cassava became totally unsaleable in most districts. Relieved of anxiety about his own food supply, and with practically no market for any grain which he might produce in excess of his own requirements, the farmer has again planted a large area of cotton this year

(1932), and there is every prospect of a revival of export. It seems likely that 15,000 bales, perhaps even 20,000, if the price is good enough, will be exported in the next season, 1932-3. And if nothing untoward occurs, 1933-4 should see a still further revival of cotton growing.

A few years ago the question used to be discussed of how many million bales of cotton might eventually be exported from Northern Nigeria. If the population, which is at present very irregularly distributed, could be ideally redistributed, so that all the vast empty tracts of the country could be populated; and if those tracts were provided, as would then be feasible, with railways and roads, then the whole country would be so different that it is perhaps almost conceivable that something approaching a million bales of cotton might be produced. It seems to serve little purpose to discuss such ideas. But if we restrict ourselves to actual conditions and " practical politics," then it is feasible to estimate the maximum production possible. The cotton-exporting districts are now fairly well served with roads, and further extensions will have only a slight effect on production. No doubt some increase will result from such general advance and development as may reasonably be expected to occur within, say, ten years. Allowing for such considerations, a reasonable estimate of the maximum possible production would seem to be 50,000 bales. This is the figure which is considered to represent a possible bumper export, which might be attained if we had again a reasonably high price of cotton for two or three years—mid-American at 6d. to 8d.—and assuming that groundnuts continue to fetch a price that makes them a competitor of cotton. This figure is also based upon the supposition of farming methods remaining substantially what they have been in the past.

Our estimate does not take account of the possibility of a revolutionary change in the agriculture of the country. Such an agricultural revolution is not only possible, but has begun; and it happens that conditions especially favour its spread in the districts which grow cotton for export. Thus ten years may suffice to make our previous estimate out of date.

The revolution in question is " mixed farming "—that is, the simultaneous adoption by farmers of the practices of using cattle for ploughing and of deliberately making and storing farmyard manure. To explain the significance of this change, it is necessary to diverge for a moment to give a short account of the farming in the belt of Northern Nigeria in which cotton is produced for export.

From early or mid October until April there is normally no rain

whatsoever; and during these months it is not feasible to do anything towards preparing the land for the next season's cropping; at all events, it is certainly not feasible to do such work by hand. The first showers fall in April, and usually amount to a total of between 1 and 2 inches, sometimes more, seldom less. In May showers become more frequent, generally making a total for the month of 4 to 6 inches. It is only from June to September that the rainfall is really adequate: in each of these months the total is normally between 6 and 12 inches. The intense dryness of the atmosphere of the dry weather is only very gradually mitigated, and in April and May, even in June or early July, the soil dries out rapidly whenever there is a break in the rains. The grain crops, on which the people live, must be sown as early as possible. Planting starts with the first shower in April; and in order to get the grain crops started early, they are frequently planted on unbroken land, which cannot then be weeded and tilled until the crop is visible. Some proportion of the grain crop has generally to be replanted because of the occurrence of a break in the rains soon after the fields were planted. Groundnuts are better sown in June than July, and cotton should be in by almost the middle of July. The land for these crops has to be tilled and cleaned before they are planted. Weeds, especially grass, grow with tropical rapidity during these early months, so that for good yields the growing crops need a good deal of weeding. All this work is done with hoes, and in May, June, and July farming is truly a race against time and weeds. Men, and commonly also the women and children, ply their hoes from sunrise to sunset, whenever the soil is moist enough to be worked. There can scarcely be a much harder-working population anywhere than the farmers on the heavier soils of Northern Nigeria during these few months of the year. (It is on those heavier soils that cotton is grown for export.) The family grow exactly as large an area of crops as they are able to plant and weed during these months; which for a man with one wife and one child big enough to work seems to mean three or three and a half acres. But there are inevitably many fields of all crops which are sown much too late to give a maximum crop, and there is hardly a field which would not give a better yield if more frequently weeded. In most of the cotton-exporting districts there is land to spare, and labour is the limiting factor.

The annual six months' dry fallow is an exceedingly dry fallow; it has undoubtedly a great fertilizing effect, but it will not suffice to maintain a reasonable, let alone a high, out-turn of grain. Some land is manured by herding cattle upon it during the months of

December to March, and both village cattle and those of the nomad herds are used in this way. No statistics are available of the proportion of the land that is thus manured; but, at a guess, it would seem that it is considerably less than 10 per cent. Periodically a part of the land has to be allowed to go out of cultivation for a resting period of several years' duration, and a corresponding amount of new land has therefore to be cleared and brought into cultivation. Even so, the crops on unmanured land are generally poor. There is thus scope for a very great increase of production, either by the introduction of labour-saving methods, or by the provision of any manure that is economically feasible. Mixed farming does both.

At the moment the capital required to purchase a complete outfit of bulls and implements is about £5. At present prices this is the value of about four or five acres of average groundnuts or cotton in the cotton-exporting belt. The experience both of the Agricultural Department and of ordinary farmers shows that, in the cotton-exporting districts, a man with a wife, one child, and two cattle, can cultivate some ten to twelve acres instead of the three acres or so which they could work by hand. Naturally nine acres of new land cannot be cleared and broken up in the first season, in addition to working the original farm; the total area will not be attained until at least the third year. Actually it seems that the man who uses a pair of cattle on ten or twelve acres can, and does, weed and intercultivate his crops much more often and more thoroughly than can a family who work by hand; and it is possible that the eventual average increase in the size of farms may be rather more than is suggested at present. Apart from really bad luck—a bull dying, or much damage being done to crops by locusts—the mixed farmer should almost recover his capital outlay by the end of the second year.

The following table shows the number of farmers who have taken up mixed farming in the Zaria Emirate to date:

Year.	*Number Starting for First Time.*	*Failures.*	*Number at End of Season.*
1928	2	—	2
1929	1	—	3
1930	4	2	5
1931	21	2	24
1932	43	—	67

Before these figures are condemned as too small to justify such a phrase as "agricultural revolution," allowance must be made for

the fact that to encourage people who had never been used to keeping cattle was a step which involved many problems, difficulties, and even danger, in the purchase of the cattle, their inoculation against contagious diseases, and their protection from tsetse, or cure if they became infected with " tsetse disease." Experience has now shown that, as a rule, even the Hausa farmer, with no previous experience of keeping cattle, takes to it with enthusiasm, and immediately takes a pride in his animals; but it could hardly be assumed in advance that they would do so. It was only at the end of the season of 1930 that we felt that we dare offer to help every promising farmer who was willing to try the new plan. So far, it has been only very exceptionally enterprising individuals who have been willing to make such a bold departure from their traditional methods; and they but hesitatingly and tentatively. During the current season (1932), however, public opinion has clearly changed a great deal. The large areas of excellent crops grown during this year by those who started in 1931 have greatly impressed their neighbours, and every one fully appreciates that driving cattle for six or seven hours a day is a much easier task than twelve hours' back-breaking hoeing. The corner has been turned, and there is every reason now to anticipate rapid progress. It seems likely that the limiting factor during the next few years will be the capacity of the Agricultural Department to give the necessary assistance in training men and cattle and arranging for the supply of inoculated cattle. The Zaria Native Administration, though in some temporary financial difficulty, is giving invaluable help through a sound system of advances for the hire purchase of cattle and implements, in order that the benefits of the new system may not be restricted only to the wealthier farmers. If this scheme is as successful as it promises to be, the financial difficulty will be overcome. In any event, mixed farming has clearly come to stay; and there is no doubt that it would spread, though of course comparatively slowly, even if the movement were not fostered by Government any further.

Ploughing with cattle makes the present custom of rotational fallows of many years' duration, " shifting cultivation " as it is called, impracticable. For when all the stumps and roots have been got out of the land so that it can be ploughed without difficulty, it is undesirable to allow it again to revert to natural grass and bush—even if land were available for the purpose. In many instances mixed farmers will be able to bring the whole of their land under annual cultivation, so that they will not have enough land for shifting cultivation, even if it were desirable. Thus there might seem to be a

danger that the final result of the farmers taking up ploughing would be merely that they would annually grow a larger number of acres of crops, which, as soon as the soil was exhausted, would give poorer yields per acre. But experiments have revealed a remarkable fact which provides the solution of this difficulty. This fact is that in Northern Nigeria farmyard manure, applied in very small dressings, has an extraordinarily great effect, especially on the grain crops, guinea-corn and gero (*Sorghum vulgare* and *Pennisetum typhoideum*). Dressings of 2 tons per acre have as great an effect as in most countries would result only from the application of several times that quantity: sometimes, indeed, 2 tons per acre here give a maximum crop, and no further increase at all results from the use of 3 or 4 tons per acre. So great a return from so small a weight of manure is partly accounted for by the relative dryness of the manure; but this does not wholly explain it, for similar increases can only be attained with artificial manures if they are applied in relatively heavy dressings, and the explanation of the remarkable efficiency of such small dressings of farmyard manure is still to be found. But whatever the explanation, the fact is certain.

The " farmyard manure " mentioned is farmyard manure in the English sense—that is, manure made by animals kept under a roof and provided with bedding. Experiments show that the manure made by one animal in one month in this way is as valuable as tethering the animal on the land in the native fashion for two months. And moreover in this way manure is made throughout the year, whereas the native way of " kraaling " on the fields is generally only feasible for some four months or so in the year. In this relatively dry climate the amount of farmyard manure that is made by one animal under a roof is only about 2½ tons per year, so that the manure made by two animals will do little more than suffice for the farmer's grain crops. However, experiments are now being made to ascertain whether a roof is really necessary either in the interest of the animal or of the manure; and if it proves unnecessary, then the amount of bedding which each beast will convert into manure will be greatly increased. Moreover, there is every reason to expect that, as soon as they have acquired the necessary capital by their increased profits, mixed farmers will take to keeping cows for breeding and milk, as well as bulls or bullocks for work. Naturally their supply of manure will then increase proportionately. (The mixed farmers of several years' standing have already acquired cows, and find them profitable.)

To the native farmer of Northern Nigeria, keeping cattle in small pens and providing them with bedding is just as revolutionary an

idea as ploughing is; and, at the beginning, it was feared that, in spite of our efforts, ploughing might be adopted, without the necessary corollary of manure-making, through which alone can fertility be maintained. However, recent experience again shows that the corner has been turned. The new mixed farmers of 1931, who in that year needed constant urging in this direction, have already seen the value of the manure in their crops this year, and have already shown by their actions that they now appreciate that the manure is worth the little trouble which the carriage of the bedding gives them.

The figures given below show the increases effected by a dressing of 2 tons per acre of farmyard manure on guinea-corn at Samaru on various fields. The increases are from nearly four to nearly eight times as great as the standard errors of the average increases. Some of the experiments were carried out in randomized blocks, some on the alternate strip plan with adjacent controls.

Year.	*Size of Plots.*	*Average Yield of Unmanured Plots (Pounds of Grain per Acre).*	*Number of Manured Plots.*	*Average Increase on Manured Plots (Pounds per Acre).*	*Increase as Percentage of Yield on Unmanured Plots.*
1929	$\frac{1}{4}$ acre	213	4	275	129
1930	$\frac{1}{10}$ acre	461	4	322	69
1931	$\frac{1}{32}$ acre*	852	8	332	39
1932	$\frac{1}{8}$ acre	781	9	461	59

The yields of ordinary farmers' unmanured fields vary almost as much as the yields of the various unmanured series of plots quoted above; and it is as difficult to say what is the average crop of guinea-corn as to say what is the average increase that, on the basis of the above figures, can be expected in future from 2 tons of farmyard manure per acre. A reasonable figure to represent an average crop of guinea-corn is perhaps 600 lb. It would seem that the increase that may be expected as a result of manuring such a field is at least 300 lb. Thus two acres of grain crop should suffice for a family instead of the three which they grow at present. As the owner of two cattle should have 4 or 5 tons of manure, it will suffice for manuring the whole of his grain crop. Few of the pioneer mixed farmers yet grow any crop specially for fodder, but manage to maintain their cattle on wild grass and the by-products of the farm. The growing of fodder crops will probably only spread as farmers take to cow-

* The border effect appreciably reduces the apparent increase due to manuring when plots are so small as this.

keeping. The crops will almost certainly be grown in such a way as not to necessitate a reduction of the area of other crops.

The market for grain in the Northern Provinces is limited to the big towns and tin mines, and supply balances demand. Thus the increased area of crops grown as a result of mixed farming must consist mainly of saleable crops. The proportions in which groundnuts and cotton will share in this increase will depend on their relative prices in the world market, and will vary from time to time as those prices vary. On the relatively heavy soils of the cotton-exporting belt, groundnuts do not yield well—they yield here but little more than half what they yield on the light soils of Kano. Average yields in the former districts are perhaps 400 lb. of decorticated groundnuts and barely 200 lb. of seed cotton. Thus at present, with groundnuts selling at a little over a halfpenny per pound, while seed cotton fetches rather under a penny per pound, groundnuts give a distinctly higher monetary return per acre. There are, however, obvious advantages in a diversity of crops, which lead the farmer to grow some cotton even when the price of seed cotton is not double that of decorticated groundnuts. For one thing, he has learnt that growing some of each is a safeguard against the vagaries of the markets. For another thing, cotton can be planted after it is too late to plant any more groundnuts. A still more important consideration is the fact that the harvesting of groundnuts on heavy land is so laborious that, if a mixed farmer put all the land which he does not need for grain into groundnuts, he would find it almost impossible to harvest so great an area. Lastly, there is reason to believe that cotton may come to be recognized as the crop that can most profitably follow manured guinea-corn, to take advantage of the residual value of the manure which was applied to the corn crop. For there is some evidence that, on heavy soil, unmanured guinea-corn following manured guinea-corn benefits only very slightly from the residual value of the manure; and, on the other hand, that cotton benefits almost as greatly from following a manured corn crop as it does from direct manuring. Farmers do not consider it generally profitable to manure groundnuts; so, if the observations just mentioned are substantiated by experiments upon these points (which are now being undertaken), mixed farming should lead to a considerable improvement in the average yield per acre of cotton.

The heaviest crops of cotton that can be grown in Northern Nigeria are very light. On naturally well drained land, manured heavily (by local standards), the highest yield that can be obtained seems to be about 500 lb. per acre. Such a crop, in most cotton-growing

countries, instead of being a maximum one, would be regarded as a poor crop. Yet it is nearer thrice than twice the present local average figure. Many fields can be seen every year which cannot yield 50 lb. per acre; and the average of all the fields is considered to be under, rather than over, 200 lb. per acre. The causes of these poor yields are lack of manure, late planting, and, less commonly and to a less extent, inadequate weeding. Thus mixed farming should lead to a great improvement of the average yield of cotton per acre as well as an increase in the number of acres. A simple calculation based on the figures given above will show that when eventually every farmer is a mixed farmer, the production of cotton is likely to be many times what it is at present. The calculation is indeed so startling that one hesitates to make it. In ten years' time every farmer will not yet be a mixed farmer, but it does not seem extravagant to anticipate that by that time this revolution in farming will have spread so much that the export of cotton may be twice as great as the maximum that is considered to be feasible at present.

Received October, 1932.

IMPROVEMENTS IN FUMIGATION

Being an account of work carried out at the Biological Field Station of the Imperial College of Science and Technology.

BY

DR. A. B. PAGE.

[The Corporation frequently receive small packets of cotton seed from various countries for transmission to other countries for experimental purposes. With a view to minimizing the risk of the introduction of fresh pests in the countries to which the seed is forwarded, all such packets are fumigated and treated by heat in this country before being sent to their destination. This work has been carried out at the Biological Field Station at Slough through the courtesy of the Imperial College of Science and Technology. It is thought, therefore, that the following account of the work carried on at Slough will be of interest to readers of the Review.—ED.]

A SURVEY of relevant literature makes evident, on the one hand, the difficulty of finding new fumigants and on the other the lack of knowledge regarding the application of existing ones. This was equally true when, some four years ago, our attention was first given to the problems involved in fumigation. It was decided in consequence to study the actual behaviour of fumigants with a view to improving methods of application, since this seemed more likely to yield results of value and to be more suited to the constitution of the station. The first problem to be tackled was that of the behaviour of mixed fumigants. These consist generally of two compounds, the one highly toxic to insects but inflammable, the other less toxic to insects but non-inflammable. A mixture of the two is selected which possesses the maximum toxicity compatible with non-inflammability. The non-inflammable constituent, of which enough must be used to confer non-inflammability on the mixture, is commonly carbon tetrachloride; another available compound, very like it and rather more toxic, is trichlorethylene. If one of these is mixed with an inflammable toxic substance—*e.g.*, carbon bisulphide—then a "mixed fumigant" is made which will behave more or less like a single compound according as the two constituents have more or less similar physical and chemical properties. If, for example, the vapour pressures of the two compounds at room temperature are wide apart, then it is likely that one will evaporate much before the other. In consequence, the properties of the fumigant will tend to

vary with time. The first part evaporated may be highly toxic but inflammable, while the last part may be but slightly toxic though non-inflammable. It may happen further that the two constituents may diffuse at different rates, while one may also be denser and may therefore " layer " more readily than the other. It is obvious that such a mixture must not be exposed except in the actual fumigation space. It is liable to change in composition, for example, on pouring from one vessel to another. With the object of throwing some light on the behaviour of these mixed fumigants, measurements were made of the partial vapour pressures of the constituents of several of them. Further, their inflammability was tested, and their toxicity to a common pest of stored products—viz., the flour moth, *Ephestia kühniella* Zell.

From the measurements of vapour pressure and of inflammability the most suitable mixtures were selected. These were such that either the bulk of the vapour was non-inflammable or, still better, the liquid and vapour conditions were identical, so that the mixture behaved practically as a single substance. In the determinations of toxicity an attempt was made to standardize both the physical and the biological conditions. The temperature and humidity were kept constant, as was the time of exposure. The dosage was sufficiently accurate, and the fumigation chambers were all exactly similar. The insects were bred under conditions which, it was hoped, would render them approximately standard. It seems, however, that the difficulty of breeding this moth in a really healthy state in the numbers required is greater than was supposed, so that the results of the toxicity tests are less regular than could be desired. The problems of breeding insects suitable for experiments on fumigation continue to receive attention. The main facts which emerged from this work are:

(1) Carbon bisulphide cannot be safely used without such high dilution as to give the fumigant a low toxicity.

(2) The fumigants vary greatly in their toxicity to different stages of the insect, mixtures containing carbon bisulphide being relatively non-toxic to eggs.

(3) A mixture of 60 per cent. ethylene dichloride and 40 per cent. trichlorethylene behaves nearly as a single substance. It is moderately toxic and is non-inflammable. Another advantage over mixtures containing carbon bisulphide is its reasonably pleasant odour.

The fumigants of this type must be applied at a fairly high temperature. Their chief use is for the fumigation of materials stored

in bulk where the somewhat large quantity of fumigant needed does not matter and where penetration occurs mainly by the action of gravity.

They have the advantage, too, that they are fairly innocuous to man, and owing to their high boiling-points they may be transported in ordinary drums and handled in simple containers by unskilled labour. In toxicity per unit weight they cannot, of course, compare with the three common fumigants, hydrogen cyanide, ethylene oxide and chlorpicrin. Chlorpicrin has received but little attention in this country. Its extremely powerful lachrymatory effect, and more especially its harmful delayed action on the lungs, seem to limit its use to special chambers worked by a trained staff and equipped with a suitable system of ventilation. Many samples also have a corrosive action on metals and a bleaching action on cloths and on flour. Hydrogen cyanide and ethylene oxide are thus pretty much in a class by themselves. Ethylene oxide is the more volatile, while hydrogen cyanide should diffuse better and is roughly six times more toxic. They are both suitable for the fumigation of most stored products where speed of distribution and of diffusion and penetration is of primary importance.

In view of the undoubted toxicity of these fumigants our attention was turned, in considering them, to their actual behaviour under the conditions of practical fumigation. Our work has shown why only partial success is so frequently attained, and has led to suggestions for improved methods of liberation, one of which is now being tried out by one of the big chemical manufacturing companies. The basis of the work is the collection of samples of the atmosphere containing gas from any point and at any time during the fumigation. For this purpose an apparatus has been evolved from the original vacuum bottle. This, as its name implied, was a bottle containing a reagent for combining with the fumigant and evacuated through a capillary tube subsequently sealed. It was placed in the space to be fumigated. When a sample was to be taken the capillary was broken by pulling on a cord attached to it which led outside into the open air. The method is positive and accurate, but this original apparatus is clumsy and uncertain in action. The essential modification introduced in our apparatus is the substitution of the cord by an electrical method of opening the vessel.

After collecting the sample of air it is necessary to determine the amount of fumigant in it by appropriate methods of chemical analysis.

Coming to the studies of actual fumigations by the methods indicated, some very interesting results have been obtained. It

should be mentioned here that a large number of samples must be used to obtain such results, often sixty or more at a single fumigation. The actual concentration of fumigant realized is always much less than that calculated from the cubic capacity of the building and from the dosage. The concentration commonly reaches a maximum within half to one hour of the start and falls fairly rapidly to a low figure. It is affected tremendously by the kind and quantity of goods being fumigated as well as by the kind and size of fumigation chamber, its airtightness, etc. Striking differences in the distribution of gas have been observed as well as in the penetration into different goods. These differences vary with the particular fumigant used, with its method of release, with the stowage of goods, and so on. In perfectly empty and symmetrical spaces the distribution is sometimes remarkably uneven, particularly on cold days. There is no doubt that draughts and convection currents play the biggest rôle in distribution. The bad effect of low temperatures in hindering vaporization and diffusion and in promoting condensation of water from the air is enhanced by the direct effect on the insect which enters into a dormant state in which it is very resistant to fumigants. These results as well as those of methods of estimating fumigants and of sampling gases will appear shortly in the *Journal of the Society of Chemical Industry*.

The uncertainty shown to be inherent in fumigation in ordinary buildings may be reduced by the use of special chambers. These should be built so that they may readily be sealed for fumigation and opened up for ventilation. They should contain an efficient low temperature heating system. Even in such chambers the concentration of fumigant in the space will occasionally be too low. Particularly if the chamber is to contain different goods as well as different amounts of the same goods a single test of concentration during each fumigation is highly desirable. In order to adapt the work of fumigation to ordinary commercial practice somewhat unsatisfactory chambers are often used. In London, for instance, where produce is frequently taken to the quay in barges, the barges themselves are used as fumigation chambers. If they are of sound steel construction with a well-fitting ceiling and are sheeted with three or more thicknesses of tarpaulin well battened down they are fairly satisfactory, but owing to their liability to damage and to accidental leaks they cannot be recommended unless a sample of gas be drawn and analyzed at every fumigation. We have found this to be necessary even though considerable care is taken in examining the barges, loading them, and sheeting down.

Special chambers, generally in the form of steel cylinders, may be made vacuum-tight and may then be used for what is called "vacuum" fumigation. After the goods to be heated are loaded and the door properly secured, the bulk of the air is removed by a pump. Fumigant is admitted, followed by air, and the chamber closed. After a much shorter time than is necessary without a vacuum the fumigation may be finished, the fumigant pumped out, and the goods unloaded. Apart from real vacuum fumigation, such vacuum-tight vessels are necessary for the study of fumigation on a semi-large scale. We have designed and erected at Slough a plant of this sort which is suitably equipped for experimental work. It consists of a vertical steel cylinder with a dished end. It is closed at the top by a quick release lid, the joint being made good with an endless hollow gasket. A worm-driven block and tackle enables bags up to 2 cwt. to be loaded without trouble. There are numerous openings which are used for thermocouples, sampling tubes, fan shaft, manometers, etc. The pump will reduce the pressure to a few millimetres of mercury in about ten minutes. The oil in the pump is protected from the fumigant by a cold trap. This consists of a series of coaxial cylindrical chambers, the middle one of which contains concentrated calcium chloride brine. In this are placed methyl chloride expansion coils. When a practical problem in fumigation presents itself our first step is to use this plant for the preliminary study of the absorption and penetration of fumigant and the relation of concentration to insect kill. If the probable leakage of the commercial chamber is known then it is imitated in the preliminary work. Calculations based on this work are frequently confirmed in the subsequent large scale experiments.

The plant is also useful for small routine sterilizations such as, for example, that of cotton seed. Leakage is nil and dosage is accurately known. In order to make certain of thorough sterilization the seed is also heated at 60° C. for ninety minutes in a thermostatically controlled electric oven. This heating is done prior to fumigation.

It will be seen that, apart from this service of sterilization, most of our work on fumigation is of interest to the Empire Cotton Growing Corporation in that it is actually throwing light on the mechanism of fumigation in general and leading to an increase in its efficiency. The progress already made has guided us in experiments on new methods of releasing fumigants. Our experience in the control of fumigation allows us to follow closely the results of these experiments, the eventual aim of which is the complete and rapid gasification of the fumigant and its even distribution under the

unfavourable atmospheric conditions not unusual in this country. The work which is planned for the near future, dealing as it does mainly with absorption and penetration, will also be of interest, since these problems bear closely on the fumigation of cotton both as seed and when baled.

Received December, 1932.

THE SIXTH INTERNATIONAL CONGRESS OF GENETICS

BY

S. C. HARLAND, D.Sc. (Lond.)

THE Sixth International Congress of Genetics was held at Cornell University, Ithaca, New York, from August 24 to 31, 1932. Several hundred members were registered, but owing to the economic situation very few representatives of foreign countries were present. Some important countries, such as Sweden, Austria and Japan, were entirely unrepresented, as were also Australia, South Africa, New Zealand and the Crown Colonies. This is all the more regrettable since a unique opportunity was provided to see under specially favourable conditions the brilliant work on the breeding of economic crops now being carried out in the United States.

In the Plant Breeding Garden of Cornell University there were demonstration plots, each illustrating by living material the progress made in the genetics and breeding of different plants, and the investigations being carried out on various types of plant material.

The Garden was under the direction of Dr. R. A. Emerson, and members of the Department of Genetics at Cornell University had co-operated in the work. In the plots could be studied the main types of genetical importance in *Antirrhinum*, *Impatiens*, *Linum*, *Lycopersicum*, *Medicago*, *Melandrium*, *Nicotiana*, *Oenothera*, *Papaver*, *Petunia*, *Pharbitis*, *Phleum*, *Pisum*, *Raphanobrassica*, *Soja*, *Solanum*, *Sorghum*, Sunflower, *Vicia*, *Viola* and *Zea*. There were also plots showing the progress made in breeding for disease resistance in various economic plants.

Cotton and maize are the two chief crops of the United States, but the amount of knowledge on cotton is insignificant compared with that on maize. Since the early days of genetics, maize has been a great centre of interest, and as the result of the labours of from thirty to fifty enthusiastic workers for the last thirty years, more is now known of the genetics of maize than that of any other living organism, except the classical *Drosophila* and possibly the Japanese Morning Glory.

The maize plots were by far the most detailed and complete. One plot was devoted to a living chromosome map of maize. Ten

linkage groups of genes have been established, corresponding to the ten pairs of chromosomes of maize. Plants carrying the appropriate genes were set out at the correct chromosome map distances apart. Other plots were devoted to material illustrating most of the genes which have been worked out in maize, and others to a series of hybrids which have been obtained between maize and perennial wild grasses (*Tripsacum* and *Euchlæna*). Triploid and octoploid types were also growing. These had been obtained by subjecting the developing ears to intermittent high temperatures, using an electric heating pad according to a method devised by Dr. Randolph of Cornell University. The economic importance of this work is very great, since the way is now opened up to the artificial production of polyploid types of other economic plants. These may possess agricultural and other attributes completely outside the range of that existing in our present material. The value of tetraploid maize is not at present known, but in many groups of plants (*e.g.*, wheat, cotton, banana) the types with higher chromosome numbers represent a great advance on the primitive diploid forms.

Maize has been singled out for special mention first because the work accomplished on it illustrates what can be done if a number of investigators working in different centres co-operate freely by unselfish exchange of results, ideas and material. It illustrates, further, what an enormous amount of spade work has to be done with any commercial crop before the results can be applied practically. It was clear that the whole programme of maize breeding in America was inspired by genetic considerations, and that those engaged in breeding work continually looked to the geneticist for further improvements in technique and method. Genetics has played little part as yet in cotton breeding, but it will certainly do so in the future.

So far as the presentation of genetic results is concerned, cotton figured but little at the Congress. A paper was presented in abstract by Horlacher and Killough of Texas on the production of mutations in American Upland cotton by radiation. They reported that "American Upland cotton, *Gossypium hirsutum*, has been found to be quite susceptible to X-ray treatment. By treatment of the dry seed many variant types were produced.

These types consisted of teratological forms and of types that were quite evidently due to somatic mutations. Dwarf seedlings were produced in large numbers, and these developed to maturity as dwarf plants. Crinkled leaves appeared frequently.

The X_2 generation, grown from selfed bolls on the X_1 plants, gave evidence that heritable changes had been induced. Chlorophyll-

deficient seedlings of a type which has been named yellow appeared among the progeny from three different X_1 plants. These plants were from three different lines of cotton, homozygous red leaf cotton, homozygous green leaf cotton, and a line which was green leaf, but which was heterozygous for virescent yellow. No yellow seedlings were found among the controls from any of these lines. The yellow seedlings have a yellow or golden colour. They are completely devoid of chlorophyll. The yellow hue is caused by the yellow pigment which is present in these seedlings. This yellow pigment is present in green cotton, but is covered up by the chlorophyll. The resin glands, which are found in all cotton leaves, show plainly as black dots on the yellow cotyledon leaves. The red anthocyanin pigment which is found in red leaf cotton appears as red flecks in the cotyledon leaves of the yellow segregates from the red leaf line. Yellow is lethal, the seedlings dying within two weeks after emergence. Yellow is inherited as a simple recessive to green, the heterozygous plants segregating into a ratio of 3 green to 1 yellow.

Two common types of leaf shape in *Gossypium hirsutum* are normal leaf and forked leaf (okra leaf). In the normal leaf the lobes are broad and the indentations between the lobes are not very deep. The lobes of the forked leaf are very narrow, almost pencil-like, and the indentations are very deep. Genetic studies have shown that a single pair of genes accounts for this difference in leaf shape. The leaf of the heterozygous plant is intermediate in shape between the shapes of the two homozygous types. Evidence has been collected from two different sources for the change of the gene for forked leaf (*n*) to the gene for normal leaf (N). A seed from a forked leaf line (*nn*) was X-rayed. The X_1 plant has leaves intermediate in shape. In the X_2 generation one plant had normal leaves, indicating that there had been induced in the X_1 a mutation from *n* to N, making the X_1 plant N*n*. Self-fertilization of this plant then gave, among other combinations, the NN genotype, which developed into a normal leaf plant.

Seeds containing embryos known to be heterozygous for leaf shape were X-rayed and plants grown from these. The bolls from these plants were selfed and the individual boll progeny grown separately. Normal segregation for leaf shape gives 1 normal leaf, 2 intermediate leaf, 1 forked leaf. A mutation from forked to normal in a branch of the heterozygous plant (N*n* to NN) would produce a boll from which all the progeny would have normal leaf shape. Among 529 individual boll progenies two separate bolls from different plants each produced eight normal leaf and no inter-

mediate or forked leaf progeny. The odds against this being a chance deviation from the 1 : 2 : 1 ratio are 262,143 : 1. Besides these, 1 boll produced 5 normal leaf plants and 1 boll produced 8 normal leaf plants. In each of these cases no intermediate leaf or forked leaf plants were produced.

The normal leat, as indicated above, has much more leaf surface than has the forked leaf, and therefore it provides the plant with more food-making surface than does the forked leaf. Considered on this basis, the mutation from forked leaf to normal leaf is progressive.

A mutant type of *Gossypium hirsutum* known as virescent yellow is partially deficient in chlorophyll. It has sufficient chlorophyll that it grows to maturity. Virescent yellow is a simple recessive to green. Several hundred seeds of virescent yellow cotton were X-rayed. A considerable percentage of the plants grown from these seeds had green areas. From self-fertilized flowers on some of the plants with green areas 66 progeny were grown. Of these, 13 were normal green plants, which were the result of mutations from virescent yellow to green in the original X-rayed seeds.

The green plants resulting from the induced mutations from virescent yellow to green were larger, thriftier, and more vigorous than the virescent yellow plants from the same bolls. It is advantageous to the plant to have the amount of chlorophyll that is present in the normal green plant rather than the smaller amount that is in virescent yellow cotton. The induced mutation from virescent yellow to green is, therefore, a dominant progressive mutation."

In the laboratory buildings there was an exhibit of living plants of cotton from the United States Department of Agriculture and also numerous exhibits dealing with fruit genetics, and breeding coffee and banana, tree breeding in relation to forestry, and cytology.

The general programme included over two hundred papers which were presented in sectional meetings.

Received December, 1932.

DIFFERENTIATION OF HAIRS ON THE SEED COAT OF COTTON

BY

V. R. AYYAR, L.Ag.,
Acting Cotton Specialist, Coimbatore,

AND

G. S. AYYANGAR, M.A.,
Assistant to the Cotton Specialist, Coimbatore.

In a recent issue of this Journal, Barritt [4] has affirmed that the evidence adduced by Gulati and Farr for the continuous differentiation of hairs from the epidermal cells of the cotton ovule is unreliable, on the ground that the counts of hairs and determinations of areas of cells were all made from the surfaces of seeds, and that the cytological evidence presented was " too vague to be convincing." He concludes, as the result of observations made by him on the nature and the size of the nuclei in the epidermal cells in the sections of seven-day-old ovules of Egyptian cotton, that the occurrence of mitosis is very unlikely, and hence the statement that the " sprouting of hairs continues after the day of flowering " is not confirmed.

The observations made by the writers at Coimbatore are not in agreement with the conclusions arrived at by Barritt, and since fresh evidence is available to prove that the lint hairs continue to be produced for a number of days after flower opening, it is thought desirable to present this note in advance of a forthcoming publication [1] wherein it will be shown how the primordial lint cells may be differentiated.

It may be stated at the outset that we did not detect (in the sections of Cambodia cotton ovules) actual mitosis in the epidermal cells beyond the second day after flower opening (Fig. 1), but the nucleus was quite prominent in them till they were twenty days old.

It has been observed that the primordial lint cells undergo several nuclear changes before they develop as hairs. The first transformation is the enlargement of the cell. The resting nucleus also grows bigger and becomes more chromatic (Fig. 2), showing faintly a few chromatic beads. Subsequently it becomes clear, and this is followed by the appearance of two or three nucleoli. These then fuse and emerge as a single big nucleolus (Fig. 3), by which time

the cell also protrudes from the epidermal layer. These changes are so distinct and so regular in the history of the development of the lint hair as to make the presence of a dark nucleated cell in the epidermis a sure indication that such cells are forerunners of hair cells. These primordial lint cells have not been noticed later than in sections of seven-day-old ovules (Fig. 4). Incidentally attention may also be drawn to a cell with a dark nucleus in the camera lucida drawings of the sections of the seventh and the tenth day ovules furnished by Gulati [5]. This dark nucleus indicates that these cells have just undergone the first transformation, and thus supports the statement that fresh crops of hairs continue to be formed on the seed coat after the day of flower opening.

Barritt [3], [4] also speaks of the constricted base of the lint hair. This feature is, according to him, brought about by the crushing action of the adjacent cells consequent on their tangential development on or about the fifteenth day. He states that "the base of the hair becomes pointed or flattened according to whether the pressure develops at the lower or upper edge of neighbouring cells." We are not in agreement with this hypothesis. Firstly, it is difficult to conceive how pressure will develop discretely at the edges of the turgid cells which are yet in the lengthening phase of their development. When cells increase in size, the first physical sign of their distension will be felt by the adjacent cells at the middle sections and not at the ends, and there is evidence to warrant the assumption that the normal course of growth is arrested at that stage. Even if it be granted that Barritt is correct in his contention, one would expect to see larger numbers of hairs with constricted bases than are usually noted. Secondly, our observations show that these constricted hairs do not belong to the epidermal layer at all. One of the sub-epidermal cells opposite to some of the stomata enlarges centrifugally, and gradually finds its way out between the guard cells (Figs. 5*a* and 5*b*), and shows itself as a hair. It may also be mentioned that this extension of the sub-epidermal cells was first noticed in eight-day-old ovules in the case of *Gossypium indicum*, and in twelve-day-old ovules in *G. hirsutum*. What Barritt describes [3] as giving some semblance of possibility to Bowman's idea of the sub-epidermal origin of hairs, thus seems to be an actual fact. Again, one of the microphotographs produced by him [4] shows on the surface opposite to the broad based hair a depression similar to that generally noted opposite to the stomata on the seed-coat. This is suggestive of the probability that the hair in question had its origin from the sub-epidermal layer below the stomata. These con-

siderations lead us to believe that the constrictions are not caused by the lateral development of the cells adjoining the hairs, but are only adjustments of the hair cells themselves, when they have to grow between two turgid cells. That these broad-based hairs are different in constitution from normal lint hairs is proved by their nuclear behaviour and by their reaction to cuprammonia. In the former the nucleus is less frequently observed, and does not manifest the transformations noticed in the case of lint hairs. Also, when this type of hair is treated with cuprammonia, it does not form as many beads as are found in a lint hair with a pointed base subjected to the same treatment. The striations in the cell walls are fewer, and the tip is left with a number of strands corresponding to those of the striations (Fig. 6). This differential behaviour leads us to suspect that the broad-based hairs are *fuzz* hairs, since the latter show similar reactions to cuprammonia (Balls [2]). It is not safe, therefore, to make conjectures about the nutrition of lint fibres from an analogy of the hairs with basal constrictions, when the latter appear to be entirely different in origin and constitution.

Again, Barritt states that since the number of hairs per seed is not determined by nutrition, the changes in lint weight per seed are correlated with changes in weight per hair. We take it that the above statement has been made from *a priori* grounds, as no data have been furnished. It has been found that among seeds developing in a lock of Cambodia cotton there is little relation between the lint weight and the unit fibre weight, and that the former is influenced by the number of fibres (*vide* following table).

Position of the Seed.	*Strain Co.* 1.			*Strain Co.* 2.		
	Lint Weight in Mgs.	*Unit Fibre Weight.*	*No. of Fibres per Seed.*	*Lint Weight in Mgs.*	*Unit Fibre Weight.*	*No. of Fibres per Seed.*
1. (Stigmatic end)	64·7	5·02	13,270	65·2	5·44	12,340
2.	65·6	5·34	12,680	66·4	5·17	13,170
3.	67·9	5·31	13,240	73·7	5·30	14,220
4.	68·2	5·15	13,640	75·6	5·26	14,810
5.	68·4	5·10	13,810	75·8	5·08	15,300
6.	68·6	5·18	13,640	77·7	5·00	15,910
7.	69·9	5·12	14,000	77·5	5·13	15,370
8.	73·0	5·29	14,250	82·2	5·18	16,270
9. (Pedicel end)	69·3	5·54	12,890	80·6	5·54	15,040

REFERENCES.

[1] V. R. Ayyar and R. L. N. Ayyangar (1932): "A Study of the Position of the Seeds in Cotton Locks. (In the press.)
[2] Balls (1928): "Studies of Quality in Cotton," p. 19.
[3] Barritt (1929): *Annals of Botany*, xliii., p. 485.
[4] Barritt (1932). Empire Cotton Growing Review, Vol. IX., p. 126.
[5] Gulati (1930): *Agricultural Journal of India*, xxv.

EXPLANATION OF ILLUSTRATIONS.

Fig. 1.—Microphotograph of seed coat from longitudinal section of Cambodia ovule fifty-six hours old, showing an epidermal nucleus in metaphase. (M=mitotic nucleus).

Fig. 2.—Microphotograph of seed coat of Cambodia ovule eight hours before flower opening; showing the enlarged epidermal cells with dark nucleus (H - primordial lint cells).

Fig. 3.—Camera lucida drawings of different stages of nuclear changes from the resting nucleus to the transparent nucleus with a big nucleolus in the protruded hair cell (R=resting cell).
(Zeiss obj. 1/12 mm. Eye-piece X 10, table level.)

Fig. 4.—Camera lucida drawing of the seed coat from longitudinal section of Cambodia ovule seven days old—showing a primordial lint cell amongst developing hairs.
(Zeiss obj. 1/12 mm. Eye-piece X 10, table level.)

Fig. 5*a*. and 5*b*.—Microphotographs of seed coat of Cambodia ovule twenty days old, showing a sub-epidermal hair pushing through the stomatal guard cells (S).

Fig. 6.—*a*. Lint hair treated with cuprammonia.
b. Fuzz hair treated with cuprammonia.
c. Section of seed coat of mature cotton seed, showing a hair with basal constriction and the fuzz reaction with cuprammonia.

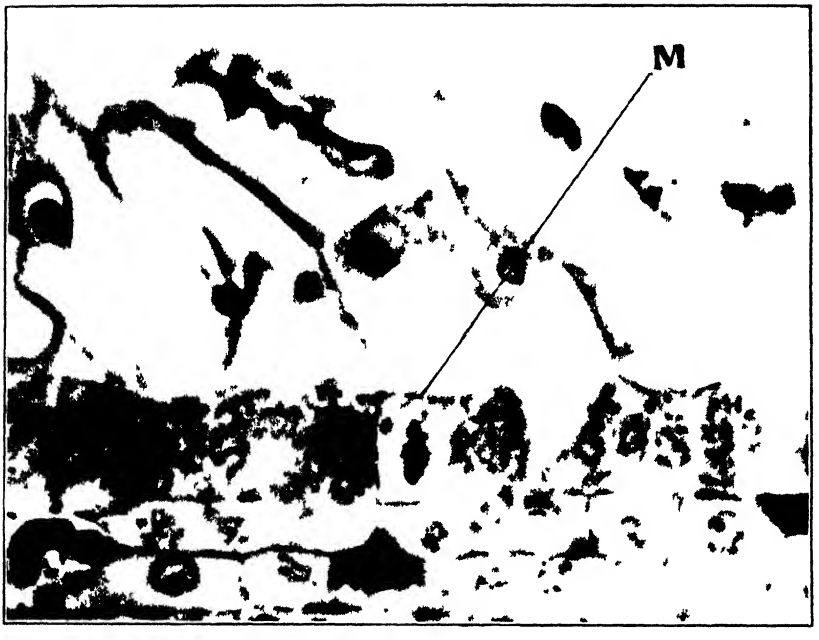


Fig 1

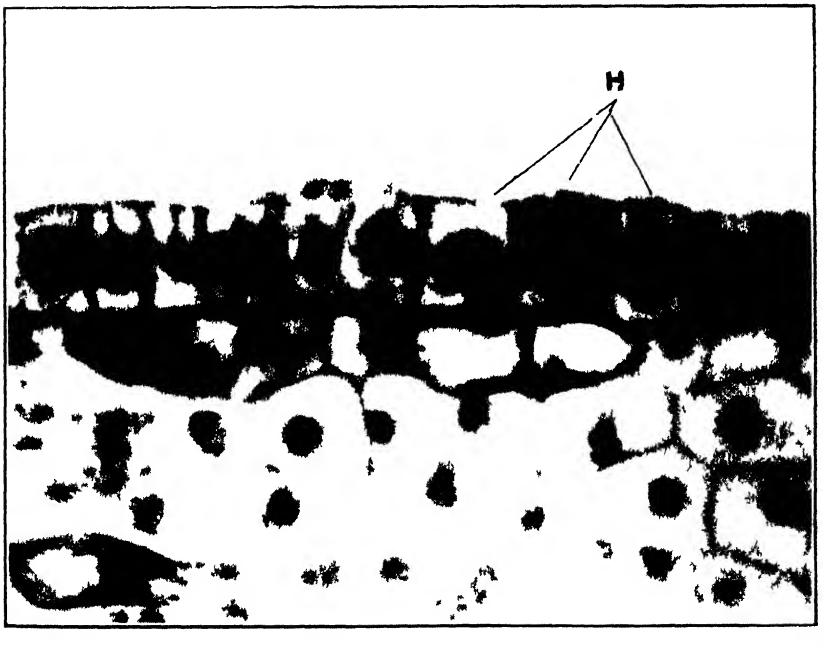


Fig 2.

NIGERIAN ORACLES

BY

REV. SIDNEY R. SMITH, PH.D.
(Formerly Archdeacon on the Niger)

AMONG the primitive people living on the eastern side of the Southern Provinces of Nigeria the most powerful agencies socially, and religiously, were the oracles, or final courts of appeal. Their elaborate machinery for encouraging and helping people to consult them, their methods of dealing with those who came, and the wealth and influence acquired by those who possessed such oracles, present a picture of primitive culture which is both interesting and instructive.

The essence of an oracle is the utterance purporting to come directly or indirectly from a god, in answer to human enquiry.

There is always a longing among people whose religion is animism and the cult of ancestors, for a god who can speak and make authoritative decisions on matters in dispute, or give directions in the ordering of the personal, family or communal life.

This desire for reference to a speaking god lent itself to exploitation and deception on the part of those whose livelihood depended upon the success of their oracles.

The conditions requisite for the establishment and development of oracles appear to be: (1) A quiet place remote from main routes and from civilization. (2) Some natural feature which inspires the sense of dread, such as rocks, caves, steep valleys with water, groves of dense bush. (3) A system by which travelling agents get to know local disputes, and encourage reference for settlement to their own oracle. (4) An easy and remunerative method for the disposal of the victims of the oracle whether alive or dead.

The chief oracles in the Ibo country were Chukwu in a town known as Arọ-chukwu, the Agbala at Awka, and Igwe at Umunọha, in the Owerri District. There were several other oracles, such as Onyili-ọra near Nri in the Awka District, and Ogba, a cave in the Nkisi stream at Ogbunike in the Onitsha District.

1. CHUKWU AT ARỌ-CHUKWU.

The most important oracle was undoubtedly that at Arọ-chukwu, or Alọ-mili, as it was often called. It was some 80 miles from Bonny on the sea-coast, 60 miles from Calabar, and 70 miles from the main

stream of the Niger above Aboh, and was thus sufficiently remote for its purpose, while at the same time it was in close touch with the comparatively dense populations of the Ibo people and the neighbouring tribes, the Ibibio, Ijọ, Jekiri, Isokos, Isobos and the Benis of the Niger Delta. Naturally a veil of mystery was carefully hung over both the place and the methods of the oracle, and efforts made by Europeans from time to time to raise it were thwarted by the determined efforts of the Arọs to keep out all inconvenient visitors.

The Arọ people are finer physically than the surrounding Ibo people, and there is no question that their acquisitive faculties also are very highly developed. Tradition says that they came from the Niger Delta, and if so, they had been in contact with Europeans for centuries, and were well versed in all the intricacies of trade, including, of course, the great trade in slaves which dominated every other interest. Whatever may have been the origin of the Arọ-chukwu people, there is every reason for thinking that their settlement in towns and villages was determined primarily by the demand for slave depots within easy reach of the coast, and that the establishment of an oracle was a device for attracting people from the surrounding country, many of whom, on being " eaten " by the god of the oracle, helped to keep up a steady supply of slaves for the local and overseas market.

The terror inspired by the threat that if a slave gave trouble to his master he would be sent to Chukwu was sufficient to enable the numerically inferior people of the Delta to hold thousands of slaves in subjection.

At the end of 1901 the British Government, realizing the menace of such a widespread organization against good government, undertook an expedition which had for one of its objects the destruction of the oracle at Arọ-chukwu and the power of the Arọ-chukwu people throughout the country lying between the Niger and the Cross River down to the sea. Colonel Montanaro commanded the columns working from three directions and converging on the towns which, taken together, were called Arọ-chukwu. In the course of these movements the Abam or Ada tribe of Ibo fighting-men was dealt with. These men were noted warriors who were hired by the Arọs and neighbouring people when any fighting had to be done.

The Arọs, hearing of the success of the columns, wisely decided to submit. Their town was occupied by troops and the oracle was destroyed—as far as this was possible.

With regard to the working of the oracle, it appeared that when

parties, bent on consulting Chukwu, arrived with their Aro-chukwu guide, they were passed on to the priest of his own quarter. After paying the large fees demanded for such privileges, they were led by a circuitous route to a gorge some 70 feet deep, approached by a narrow path which passed through three enclosures to a large hollow place below. At the bottom two streams of water poured from a rock which was surmounted by a large collection of human skulls, and decorated with streamers of cloth hanging down almost into the water. The two streams enclosed a small island, on which was a primitive altar with human skulls and other signs of sacrifice.

The pool was full of sacred cat-fish and pygmy crocodiles, and the fact of there being water (mili) at this, the centre of the oracle, doubtless led to the use of the name Alọ-mili, which was frequently given to the place.

The case requiring settlement was presented by the Aro priest on the arrival of the parties at a place which concealed a man who personated Chukwu; and judgment was given audibly. In the case of the pre-arranged decision, the man in question was either seized, strangled or clubbed, or bound and led away to be sold. The stream was coloured by the admixture of red cam wood to make it look like blood, and the survivors of the party were told that the god had " eaten " the man as he had been declared guilty.

Sometimes a party of enquirers would be told that Chukwu demanded a human being as the price of an answer to their enquiries, and one of them would be taken forcibly. Then the party would be allowed to go home, taking with them some token that they had been to consult Chukwu.

One man, who had the good fortune to escape, said that he was blindfolded, and taken into a room where he heard a discussion as to whether he should be sold or killed. He was sold, and after passing through the hands of two or three masters, found his way to Calabar, where he was discovered by a native of Onitsha, who took him back to his own town a few miles south of Obosi, where the writer met him and heard the story.

There is no doubt that the heaviest toll of human life and of slavery was levied upon parties of men brought from remote areas of the more populous parts of the Niger Delta and the North-eastern area of the Ibo Country.

The Aros knew exactly how and when to excite the avarice of unscrupulous men who wanted to get rich quickly, and it was owing to the readiness of such men to enter into schemes for their mutual

advantage that Chukwu was such a popular oracle, and that it became a huge depot for slaves.

The name given to the people of Arọ by the Ibos of the North is Umu-Chukwu—*i.e.*, the children of God—and settlements of these people in many parts were known by this name. This has led to some confusion when it has been mistaken for a place-name.

2. The Agbala of Awka.

The writer lived in the town of Awka while the Agbala or Oracle there was in active operation. Long streams of people from neighbouring Southern tribes were led by Awka blacksmiths from their homes, where the blacksmiths had been plying their trade. A family quarrel, or an accusation of witchcraft, or theft or murder, which seemed impossible to settle locally, was skilfully engineered by the Awka smith, so that the disputants agreed to refer the matter to the Agbala at Awka. In the case of people who came from what was known as the Olu country—*i.e.*, the Niger Delta, and district inhabited by Isobos, Isokos, Irọs and Jekris—they usually came up-river in canoes. Although Awka is only 21 miles from the Niger at Onitsha, the way to the Agbala was made much longer, for two reasons, first, because the shorter route lay through towns whose people were very wild and who would not have hesitated to attack a caravan consisting chiefly of strangers unless it had been made worth their while to let them pass; and, secondly, because the longer way lay more or less among the people who were connected with Awka, and who aided them in matters connected with the Agbala, including the capture of runaways.

The canoes made their way past Onitsha and up the Amambala Creek, to a place called Nneyi, and thence the party went by land through Naudo and Achala to Awka, a distance of about 90 miles in all. The people who made up these parties and who numbered from a dozen to fifty persons carried loads of cloth, money, cases of gin and other gifts to the Agbala. On arrival at Awka they were quartered in the town and made to wait until their gift had been presented and the Agbala informed of the desire to consult him. When the time for consultation came they were taken to the place of the oracle, which was just on the outskirts of the town, not far from the stream Obibia. One by one, and blindfolded, the men were taken down a steep gully, and a mock ceremony took place, during which the case was stated and the answer given by the Agbala. The answer was really given by a man who spoke into a small clay pot, and it was interpreted by an Awka smith. Then the consultant

was allowed to go, if he had paid enough money, or he was either killed and his body cut up and flesh sold in the market, or seized, bound and sent away to be sold as a slave.

The rest of the man's company were told that the Agbala had " eaten " him, and they were allowed to return home.

It seems clear that while thousands of human beings were done to death or sold as slaves, there were many consultants who were allowed to return home to enhance the reputation of the Agbala, which had shown such an intimate knowledge of matters submitted for settlement.

On two occasions the writer came across people who had been " eaten " by the Agbala. Once, in the town of Nnewi, when he was staying in the compound of a big chief, he received secret messages from some men who were held as slaves by the chief to the effect that they were the victims of the Agbala and sought help to escape. As there was then no effective control of the country by the Government, it would not have been wise to have attempted to assist them.

On the second occasion, in the Isoko country, a number of old women appeared and said that some years before they had gone to consult the Agbala, and that on entering the place of the oracle they were seized and afterwards sold as slaves into the Efik-speaking country. When British control was extended they took advantage of the opened country and made their way back to their own homes. As witchcraft was the accusation which led to the visit to the Agbala, it can be imagined that the return of people who were supposed to have been " eaten " by a god was by no means welcomed by those who were responsible for their condemnation, and had benefited by their removal.

The system of dividing the country up into districts, which were allocated to the families of Awka blacksmiths, who went and plied their trade for about nine months in the year, returning home about October, lent itself to the practice of the smiths leading large parties of people to consult the Agbala at Awka. The fact that the Awka smith could speak the language of the tribe in which he worked begat a certain amount of confidence, which enabled him to become an accessory to any local designs to remove enemies, or people suspected of witchcraft, by the simple device of getting them to agree to submit the charges to the decision of the Agbala.

Many times has the writer seen people from another tribe filling up the period of waiting to go into the Agbala, by walking about the town and visiting his compound, quite ignorant of the fate that awaited most of them. Many of these were from the very Isoko

tribe which, some years afterwards, he visited, and among whom he found a mass-movement away from animism to Christianity.

One very vivid impression remains of his boys returning from the local market one day, saying that they had seen some strange-looking meat for sale—very fat. On asking what meat it was, they were told "anu Olu"—*i.e.*, meat from the country of the Lower Niger—the flesh of the Olu people who had come to consult the Agbala. The blacksmiths themselves were not cannibals, but the surrounding towns were by no means averse to eating human flesh.

Again and again attempts were made by the writer to find out the site of the Agbala at Awka, but every time armed men very politely but firmly barred the way.

When the Agbala was broken up by Government troops in 1904, it was found to consist of a narrow water-worn gully with trees almost overarching all the way to the bottom, where there was a small stream. A few pots about 4½ by 6 inches were found, which were used to speak into, to disguise the voice by those who personated the speaking god. It was stated that the Agbala required the sacrifice yearly of a large number of human lives in order to make it effective.

At the entrance to the Agbala was a large tree into which nails and iron staples were driven. The method was probably that employed in sympathetic magic, as one way of dealing with the personal enemies of those who consulted the Agbala. The tree for the time being stood for the person whose hurt was sought, and every blow upon the nail or staple was accompanied by the malediction of the hammerer in the belief that it would thereby injure his enemy's body.

It was not likely that such a source of wealth as the Agbala would be renounced simply because the Government had destroyed all that could be destroyed in the oracle itself, and had forbidden its revival. The Government District Headquarters with European officers and police were established within two miles of the oracle and a metalled motor road passed within one mile. The persistent rumours that people were being led to the oracle, and that its power was again being established, were to a large extent discounted, because of the obvious risks of discovery. It was known that the Agbala was supposed to require human sacrifices to maintain its efficacy, so early in 1921, acting upon information that a human sacrifice was about to be made, a surprise visit was paid by two Europeans, a Political officer and a Police-Superintendent, to the vicinity of the old Agbala. Nothing could be seen or heard, and they thought they must have been misinformed, when one of them caught sight of some blood on a leaf, and then found signs of the

dragging of a heavy body. This led to the discovery of the body, still warm, of a man who had been killed and buried hastily. His head had been reduced to pulp by cudgels.

There was no evidence to convict any Awka people until, by a curious coincidence, in a case in the Ahoada District Court, nearly 80 miles distant, the Agbala at Awka was reported to have made a decision about a stolen cannon. It also came out that a party had been led by an Awka man to consult the Agbala, and that the one man who had not returned was the murdered man found by the two European officers. The result was that two Awka men were publicly hanged in Awka on April 4, 1921.

The Agbala at Awka and the oracle at Arọ-chukwu seem to have had a good many features in common. Naturally there was no love lost between the Awka smiths and the Arọ traders, as they were rivals in a most profitable business in human beings.

The Awka blacksmiths visited distant towns and lived among the people for nine months in the year, while the Arọs established little settlements of their own people at the crossings of rivers and at the intersection of main roads. Ostensibly the latter were traders in cloth, beads, etc., obtained from the coast and from German territory. They introduced a special dark blue cloth called " blagidi " (a corruption of the word " blanket "), among other things, in the various interior Ibo markets which they attended regularly, while ever alert to buy up a few slaves or to dispose of others.

Both the Arọs and the Awkas were a very close confederacy. Among the latter there was considerable jealousy between the different villages, some of whose men were devoted more to the work of " medicine," whereas the more dominant and richer villages were blacksmiths.

It is significant that the Awka Agbala was situated within a few miles of the town of Nri, the seat of a kind of priest-king, whose reputation extended beyond the boundaries of the Ibo country. Men from this town travelled throughout the land bearing a short staff ornamented in the middle by a lump of clayey stuff stuck with feathers, which was a passport and protection everywhere. Their work was to remove " abomination," the result of the breaking of taboos, and offenders were often handed over to them to dispose of at their discretion.

Of the remaining oracles in the Ibo country, one was at Ununọha, near Oguta, and known as Igwe—*i.e.*, the sky or the heavens—which was destroyed by the Government because of its bad influence.

Another was a cave in the bed of the Nkisi at Ogbunike, a few

miles from Onitsha. To this place came the people of the neighbourhood as to a kind of court of appeal with cases of theft. The accused persons were required to pass through the cave. If they came through unharmed or unmarked, they were regarded as innocent, but if they failed to return, their guilt was established, and they were either sold as slaves or held until their families had paid enough money to satisfy every demand.

The remaining quasi-oracle was called Onyili-ọra, and it was situated at Ujali in the Awka District. A priestess seems to have been in charge of it; and it was resorted to by people who desired to communicate with their deceased relatives. The name of the oracle means, "It satisfies everybody's needs," and the needs of primitive peoples, after all, are not so very far removed from those of civilized communities.

COTTON STATISTICS

CONSUMPTION AND STOCKS

BY

JOHN A. TODD, M.A., B.L.

DURING the past two seasons the outstanding feature of the World's Consumption statistics has been the marked transfer of consumption from American to Outside Growths, with the result that for three half-years in succession the world's consumption of Outside Growths in running bales, according to the Federation figures, was actually in excess of that of American. A year ago, however, we pointed out that this tendency was slackening in the second half of the season, and during the season now closed the reaction was carried still further, and the Outside Growths total fell definitely below that of American again. To complete the history of this interesting development we repeat the latter part of the table which we gave last year, with the figures for the new season added.

	AMERICAN.*			OUTSIDE GROWTHS.			
Season.	*U.S.A.*	*Rest of the World.*	*Total.*	*U.S.A.*	*Rest of the World.*	*Total.*	*Per Cent. on American.*
1929-30:	*Running bales.*		000's.	*Running bales.*		000's.	
1st Half	3,152	3,926	7,078	132	5,987	6,119	86·4
2nd ,, ..	2,651	3,286	5,937	117	5,950	6,067	102·2
1930-31:							
1st Half ..	2,372	2,901	5,273	77	5,809	5,886	111·6
2nd ,, ..	2,712	2,916	5,628	78	5,616	5,694	101·2
1931-32:							
1st Half ..	2,568	3,549	6,117	53	5,360	5,413	88·5
2nd ,, ..	2,179	4,023	6,202	47	4,543	4,590	74·0

* Excluding linters.

We also give, again brought down to date, the diagram of the half-yearly consumption of American and Outside Growths, contrasting the consumption of the United States and the rest of the world. This diagram carries the half-yearly record back to January, 1921, and it is interesting to note that the striking movement of the past season is simply a repetition on a smaller scale of what happened after the record American crop of 1926.

The extent of this reaction during the season was almost entirely

due to one section of the cotton industry, namely the Far East. As will be seen from Table I., the consumption of American cotton in Asia last season was nearly double that of the previous year, but this was largely set off by their smaller consumption of Indian and Sundries. This is of course nothing new, for the Orient has always made a habit of transferring consumption from Indian and Chinese cotton to American whenever relative prices suited the buyers; but the extent of the substitution this season was in line with the extraordinary disparity in relative prices from the normal. As we have frequently pointed out, the Liverpool quotations of Indian cotton during the greater part of last season were actually above those of American. Even now the price of Indian is high compared with American, but in view of present crop prospects the reaction will probably be carried further during the coming season.

But while the Orient actually increased their total consumption of cotton of all kinds during the past season to a new record, other sections of the industry showed a very different result. England made a fair recovery from the very low figure of the previous year, but the Continent showed a further decline, for they also used less Indian and Sundries than last year. The United States also showed a considerable decline, with the result that the world's total consumption of all kinds was actually a little less than the very low figures of the previous season. The loss was heaviest in Indian and Sundries for the reason already explained; but here it must be noted that no returns were made by Russia, and the Federation have therefore again had to estimate their consumption. Egyptian, however, showed quite a good recovery, though still short of the record. (1923–24, 1,027,000 bales.)

Table II. gives the details of the United States consumption during the past season and for the first three months of the new season. The movement of these figures last season was very disappointing. The first two months of the season showed a very substantial improvement, but this was less marked for the remainder of the year, and from January onwards the returns were increasingly disappointing, till in July the downward movement culminated with the lowest figure for any month on record. It is satisfactory to note, however, that since the opening of the new season the figures have made a good recovery, and the September total was for the first time above that of the same month a year ago. The October figure was even better, being the highest for any month since April, 1931.

The effect of the consumption figures taken in conjunction with the relative crops is shown in the World's Carryovers of American and Egyptian cotton, which are given in Tables III. and IV. In the

case of American the position has of course become very much worse during the past season. As will be seen from the following summary, the season's supply of American cotton last year was overwhelming, being actually more than 2 million bales above the previous record of 1926-27, when the crop was the largest ever grown. With consumption at such a relatively low rate the result is a new record carryover at the end of the season, the total figure being almost half a million bales more than the season's consumption, while the new season's supply is now almost up to last year's figure.

AMERICAN SUPPLY AND CONSUMPTION.

Season.	*Carry-over at Beginning of Season.*	*Crop.*	*Total Supply.*	*Consumption (Federation).*	*Season's Average Spot Price in Liverpool.*
	Running	*bales* 000's	*(ex-linters*	*throughout).*	*Pence per Lb.*
1920-21 ..	5,656	13,271	18,927	10,033	11·89
1921-22 ..	9,141	7,978	17,119	12,728	11·37
1922-23 ..	5,028	9,729	14,757	12,594	14·92
1923-24 ..	3,235	10,171	13,406	11,080	17·66
1924-25 ..	2,665	13,639	16,304	13,270	13·76
1925-26 ..	3,324	16,123	19,447	13,736	10·77
1926-27 ..	5,358	17,755	23,113	15,777	8·15
1927-28 ..	7,484	12,783	20,267	15,407	11·17
1928-29 ..	4,952	14,297	19,249	15,066	10·52
1929-30 ..	4,332	14,549	18,881	13,023	9·09
1930-31 ..	6,249	13,756	20,005	10,901	5·71
1931-32 ..	8,816	16,629	25,445	12,319	4·82
1932-33 ..	12,802	12,500*	25,302	—	—

* Based on December Estimate (12,727,000 in 500 lb. bales).

It will be noted that in this summary the whole figures are given excluding linters. The inclusion of linters in our usual Carryover table has in recent years led to considerable confusion in comparing statistics of consumption and production, for there are no statistics of the consumption of linters except in the U.S.A., and we have therefore decided to recast the American Carryover table entirely and to exclude linters. We have also taken this opportunity to show separately the new statistics of Visible Stocks in the Orient.

With regard to Egyptian the position, which is summarized in the next table, is very much better than the American and very much better than it was a year ago. Owing to the low premiums of Egyptian during the major part of last season and the strenuous efforts made by the Government to encourage the use of Egyptian in countries which formerly used only American, the stocks in Alexandria at the end of last season were considerably reduced, and although stocks elsewhere were higher the result was that the World's Carryover at the end of the season was nearly 200,000 kantars less

than a year ago. On top of this comes a heavy reduction of the expected crop this season, which we have taken in the table at the second estimate of the Minet-el-Bassal Bourse Commission (formerly the Alexandria General Produce Association), namely 4,450,000 kantars. On this basis it will be seen that the season's supply this year is very much smaller than in the two previous years and is actually the smallest since 1927. If the consumption this season can be kept up to last year's figure the result should be that the Carryover at the end of the season will be reduced to quite normal proportions, say 4 million kantars.

EGYPTIAN SUPPLY AND CONSUMPTION.

Season.	*Carry-over at Beginning of Season.*	*Crop.*	*Supply.*	*Consumption (Federation).*	*Season's Average Spot Price in Liverpool.*
		Kantars 000's.			*F.G.F. Sakel.*
1920-21 ..	3,612	6,030	9,642	3,850	30·24
1921-22 ..	4,484	4,858	9,342	5,500	19·75
1922-23 ..	4,485	6,213	10,698	6,700	17·29
1923-24 ..	3,996	6,531	10,527	7,700	21·55
1924-25 ..	2,349	7,274	9,623	7,300	29·82
1925-26 ..	2,222	7,965	10,187	6,900	20·05
1926-27 ..	3,658	8,635	12,293	7,450	15·39
1927-28 ..	4,712	6,097	10,809	7,200	19·39
1928-29 ..	3,573	8,012	11,585	7,400	18·14
1929-30 ..	4,243	8,485	12,728	7,028	14·52
1930-31 ..	6,131	7,947	14,078	6,398	9·06
1931-32 ..	6,959	6,563	13,522	7,350	6·80
1932-33 ..	6,761	4,450	11,211	—	—

It must of course be remembered that both in American and Egyptian the Government holds a substantial part of the Carryover. In America the total of all the different holdings for which they are more or less responsible is probably about 8 million bales, and they have practically undertaken to hold most of that throughout the bulk of this season, some till the end of March and some till the end of July.

In the case of Egyptian the total of the Government's unsold stocks was reduced at the end of November to about 1,220,000 kantars, and of this they are not likely to try to sell more than about half during the coming season. It is not expected, therefore, that the Government stocks will play any serious part in depressing the market, though they might be very useful to prevent any attempt to drive prices to extremes.

Looking to the future, it will be seen that the prospects of the coming season are largely bound up with the question of the world's

consumption of American cotton. On that point it must be remembered that the East last year consumed about a million and a quarter bales more of American cotton than their normal, and that excess will certainly not be repeated this year, though it must be kept in view that India, China and Japan have carried over very heavy stocks of American cotton bought at cheap rates, which they will no doubt put into consumption this season. But the fact remains that the rest of the world will have to use a great deal more American than they did last season if the total consumption is to exceed last year's figures. The Continent are not likely to do so, because they also used a little more American cotton and a great deal less Indian last year, and that tendency is likely to be reversed. England made a substantial recovery last year and is not likely to improve on it very much again. The only direction, therefore, in which we can look for a substantial increase of consumption of American is the United States themselves. They have begun well this season, but the improvement will have to be carried still further if they are to add anything like a million bales to their season's consumption.

But that is merely to say that the whole question of the world's recovery depends on the recent improvement in America being maintained and extended. The improvement began very well in August, but so far as general conditions are concerned, especially if we may take the movement of the New York Stock Exchange as an index, it was severely checked in September. The U.S. monthly statistics of consumption will therefore be watched this season with special interest.

TABLE I.—WORLD'S CONSUMPTION OF COTTON.

(From the Statistics of the International Federation.)

(*Running Bales, 000's Omitted—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*All Others.*	*Totals.*
American ..	1911–13*	3,701	4,865	5,086	513	132	14,297
	1924–25	2,344	4,009	5,917	772	228	13,270
	1925–26	2,093	4,194	6,176	1,012	261	13,736
	1926–27	2,077	4,797	6,880	1,756	267	15,777
	1927–28	1,949	5,143	6,535	1,513	267	15,407
	1928–29	1,910	4,614	6,778	1,431	333	15,066
	1929 30	1,474	4,055	5,803	1,427	256	13,015
	1930–31	991	3,242	5,084	1,345	239	10,901
	1931–32	1,342	3,343	4,747	2,636	251	12,319
	1st Half	*609*	*1,676*	*2,568*	*1,131*	*133*	*6,117*
	2nd ,,	*733*	*1,667*	*2,179*	*1,505*	*116*	*6,200*
Indian ..	1911–13*	49	807	5	3,043	1	3,905
	1924–25	183	1,108	31	4,165	34	5,521
	1925–26	168	1,063	30	4,273	38	5,572
	1926–27	82	855	28	4,203	28	5,196
	1927–28	121	962	27	3,389	24	4,523
	1928–29	183	1,150	35	3,766	44	5,178
	1929–30	188	1,375	61	4,403	60	6,087
	1930–31	252	1,215	43	4,318	35	5,863
	1931–32	183	727	21	3,834	23	4,788
	1st Half	*130*	*451*	*12*	*2,204*	*15*	*2,812*
	2nd ,,	*53*	*276*	*9*	*1,630*	*8*	*1,976*
Egyptian ..	1911–13*	384	377	127	20	7	915
	1924–25	431	350	128	49	13	971
	1925–26	391	334	136	42	17	920
	1926–27	369	389	160	51	25	994
	1927–28	358	394	145	43	17	957
	1928–29	365	401	155	43	25	989
	1929–30	301	415	137	58	26	937
	1930–31	242	420	70	96	25	853
	1931–32	301	480	53	120	26	980
	1st Half	*152*	*241*	*26*	*54*	*14*	*487*
	2nd ,,	*149*	*239*	*27*	*66*	*12*	*493*
Sundries ..	1911–13*	140	1,946	26	774	939	3,825
	1924–25	277	896	66	1,523	785	3,547
	1925–26	370	1,619	58	1,308	1,103	4,458
	1926–27	482	1,511	64	1,362	753	4,172
	1927–28	476	1,557	64	1,646	911	4,654
	1928–29	342	1,947	55	1,480	815	4,639
	1929–30	502	2,044	51	1,825	740	5,162
	1930–31	479	1,984	42	1,648	711	4,864
	1931–32	560	1,730	26	1,133	786	4,235
	1st Half	*321*	*831*	*15*	*553*	*394*	*2,114*
	2nd ,,	*239*	*899*	*11*	*580*	*392*	*2,121*
All kinds ..	1911–13*	4,274	7,995	5,244	4,350	1,079	22,942
	1924–25	3,235	6,363	6,142	6,509	1,060	23,309
	1925–26	3,022	7,210	6,400	6,635	1,419	24,686
	1926–27	3,010	7,552	7,132	7,372	1,073	26,139
	1927–28	2,904	8,056	6,771	6,591	1,219	25,541
	1928–29	2,800	8,112	7,023	6,720	1,217	25,872
	1929–30	2,465	7,889	6,052	7,713	1,082	25,201
	1930–31	1,964	6,861	5,239	7,407	1,010	22,481
	1931–32	2,386	6,280	4,847	7,723	1,086	22,322
	1st Half	*1,212*	*3,199*	*2,621*	*3,942*	*556*	*11,530*
	2nd ,,	*1,174*	*3,081*	*2,226*	*3,781*	*530*	*10,792*

* Average of 1911–13 and 1912–13.

TABLE II.—U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

		Total.	*Upland.*	*Sea Island.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
Season's Totals.	1912–13	5,483·4	5,195·6	54·8	—	201·3	31·7	303·0
	1913–14	5,577·4	5,301·4	81·7	—	151·1	43·2	307·3
	1914–15	5,597·4	5,295·9	79·4	—	181·2	40·8	411·8
	1915–16	6,397·6	5,998·0	82·6	—	269·3	47·7	880·9
	1916–17	6,788·6	6,376·0	94·3	—	259·2	59·1	869·7
	1917–18	6,566·5	6,296·8	85·9	—	136·4	47·4	1,118·8
	1918–19	5,766·0	5,517·6	51·2	21·1	126·1	50·0	457·9
	1919–20	6,419·8	5,914·2	43·0	45·9	323·1	93·6	342·5
	1920–21	4,892·7	4,641·5	18·7	16·8	159·2	56·6	516·3
	1921–22	5,909·9	5,554·7	9·0	49·4	226·3	70·5	639·0
	1922–23	6,666·1	6,250·8	6·3	65·2	262·3	81·5	646·1
	1923–24	5,680·6	5,312·0	4·9	36·0	223·6	104·0	536·7
	1924–25	6,193·4	5,894·5	4·0	19·0	191·5	84·4	658·8
	1925–26	6,455·9	6,161·7	2·3	11·7	204·1	76·0	803·8
	1926–27	7,189·6	6,859·2	1·2	19·7	239·8	69·7	806·1
	1927–28	6,834·1	6,518·6	1·3	15·1	217·6	81·5	780·2
	1928–29	7,091·1	6,763·9	0·8	13·5	232·4	80·5	879·3
	1929–30	6,105·8	5,790·4	0·4	12·6	205·8	96·7	805·2
	1930–31	5,263·0	5,067·8	0·4	15·4	104·1	75·3	714·1
	1931–32*	4,869·1	4,734·5	—	12·5	79·9	42·2	637·3
Monthly Figures, 1930–31.	August	352·3	338·6	—	0·6	7·7	5·5	57·0
	September	394·3	378·8	—	0·5	7·9	6·9	62·8
	October	444·5	426·4	—	0·6	9·9	7·7	66·2
	November	414·9	399·0	—	0·8	9·1	6·0	54·8
	December	406·2	390·1	—	0·9	10·1	5·1	44·0
	January	454·2	439·4	—	1·2	7·8	5·8	49·3
	February	433·5	417·4	—	1·3	8·4	6·4	53·1
	March	490·6	472·5	—	1·6	8·8	7·7	62·8
	April ..	508·7	490·5	—	1·7	9·7	6·9	66·8
	May ..	465·8	449·5	—	1·4	8·7	6·2	66·9
	June ..	455·4	439·0	—	1·5	8·9	6·1	61·4
	July ..	450·5	436·6	—	1·4	7·7	4·8	64·4
Monthly Figures, 1931–32.*	August	425·8	414·0	—	1·3	5·7	4·9	60·7
	September	463·7	449·4	—	1·8	7·1	5·5	63·9
	October	462·0	449·8	—	1·3	6·6	4·3	61·0
	November	428·9	417·8	—	1·0	6·6	3·4	52·7
	December	415·5	404·5	—	1·2	6·5	3·3	44·5
	January	435·3	425·0	—	1·1	6·7	2·5	50·2
	February	450·0	438·9	—	1·1	7·0	3·1	52·8
	March	488·7	475·5	—	1·1	8·3	3·7	54·2
	April ..	367·3	357·0	—	0·8	6·4	3·1	50·9
	May ..	332·4	321·7	—	0·6	6·9	3·2	50·2
	June ..	320·8	311·5	—	0·5	6·0	2·8	46·7
	July ..	278·7	269·4	—	0·8	6·1	2·4	37·2
1932–33.*	August	402·6	391·6	—	1·6	6·2	3·2	47·3
	September	491·7	479·0	—	1·8	6·5	4·4	61·3
	October	502·2	488·2	—	1·6	7·9	4·6	58·0
	November	504·0						

* Subject to revision.

TABLE III.—WORLD'S MONTHLY CARRYOVER OF *AMERICAN COTTON.*

(RUNNING BALES 000's—EXCLUDING LINTERS.)

End of	Stock and Afloat.			U.S.A.		Monthly Totals.	Federation. Other Mill Stocks.	Elsewhere in U.S.A.	Half-Yearly Totals.
	U.K.	Continent.	Orient.	Mills.	Warehouses.				
1912, August ..	508	406	—	733	556	2,203	1,305	350	3,858
1913, February	1,384	1,270	—	1,810	2,218	6,682	1,459	—	8,141
August ..	423	282	—	638	465	1,808	1,011	375	3,194
1914, February	1,219	1,338	—	1,667	2,308	6,532	1,379	—	7,911
1920, January ..	1,368	714	—	1,878	3,710	7,670	850	—	8,520
July ..	878	474	—	1,208	1,880	4,440	1,066	150	5,656
1921, January ..	840	758	—	1,153	5,543	8,294	1,050	—	9,344
July ..	839	805	—	1,021	3,639	6,304	1,137	1,700	9,141
1922, January ..	743	838	—	1,586	4,538	7,705	1,176	—	8,881
July ..	558	562	—	1,127	1,413	3,660	1,243	125	5,028
1923, January ..	605	682	—	1,909	3,412	6,608	885	—	7,493
July ..	187	206	—	982	867	2,242	713	280	3,235
1924, January ..	742	555	—	1,553	2,921	5,771	815	—	6,586
July ..	228	310	—	638	641	1,817	688	160	2,665
1925, January ..	1,016	945	—	1,372	3,837	7,170	1,004	—	8,174
July ..	401	373	—	787	487	2,048	1,046	230	3,324
1926, January ..	802	905	—	1,745	5,146	8,598	1,121	—	9,719
July ..	579	406	--	1,011	1,893	3,889	959	510	5,358
1927, January ..	1,311	1,555	—	1,787	6,133	10,786	1,193	—	11,979
July ..	1,011	1,079	—	1,325	1,803	5,218	1,731	535	7,484
1928, January ..	721	1,354	—	1,626	4,984	8,685	1,243	—	9,928
July ..	530	815	—	935	1,156	3,436	1,181	335	4,952
1929, January ..	938	1,338	—	1,697	4,574	8,547	1,260	—	9,807
July ..	442	563	—	932	923	2,860	1,197	275	4,332
1930, January ..	618	1,198	448	1,730	5,343	9,337	1,007	—	10,344
July ..	304	544	143	1,048	2,803	4,842	937	470	6,249
1931, January ..	644	1,198	343	1,523	7,895	11,603	907	—	12,510
February	628	1,185	336	1,461	7,268	10,878	—	—	—
March ..	603	1,238	437	1,392	6,618	10,288	—	—	—
April ..	573	1,109	480	1,290	5,992	9,444	—	—	—
May ..	547	1,023	424	1,181	5,450	8,625	—	—	—
June ..	488	874	407	1,056	4,934	7,759	—	—	—
July ..	436	766	401	922	4,491	7,016	950	850	8,816
August ..	371	643	321	767	4,394	6,496	—	—	—
September	320	700	477	709	6,268	8,474	—	—	—
October ..	381	801	534	1,052	9,424	12,192	—	—	—
November	452	898	731	1,381	10,674	14,136	—	—	—
December	525	1,002	856	1,575	10 406	14,364	—	—	—
1932, January ..	506	938	805	1,582	10,012	13,843	1,193	—	15,036
February	516	912	1,104	1,577	9,492	13,601	—	—	—
March ..	519	947	1,186	1,513	8,749	12,914	—	—	—
April ..	478	852	1,071	1,482	8,146	12,029	—	—	—
May ..	498	915	856	1,411	7,575	11,255	—	—	—
June ..	440	768	801	1,269	7,116	10,394	—	—	—
July ..	415	729	695	1,164	6,660	9,663	1,379	1,760	12,802
August ..	427	757	714	1,035	6,509	9,442	—	—	—
September	421	896	662	1,036	7,932	10,947	—	—	—
October ..	448	1,052	666	1,220	9,792	13,178	—	—	—
November	572	1,244	771						

TABLE IV.—WORLD'S MONTHLY CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000's BALES CONVERTED AT 7·5 KANTARS (EUROPE) AND 5·0 KANTARS (U.S.A.).)

End of	Stock and Afloat.		U.S.A.		Alexandria.	Monthly Totals.	Federation. Other Mill Stocks.	Half-Yearly Totals.
	U.K.	Continent.	Mills.	Warehouses.				
1912, August ..	302	30	424*	—	350	1,106	1,387	2,493
1913, August ..	418	31	354	13	491	1,307	1,485	2,792
1920, July ..	466	79	587	514	601	2,247	1,365	3,612
1921, July ..	688	158	345	296	1,992	3,479	1,005	4,484
1922, July ..	835	148	314	267	1,669	3,233	1,252	4,485
1923, July ..	859	129	447	265	1,096	2,796	1,200	3,996
1924, July† ..	360	128	259	63	384	1,194	1,155	2,349
1925, July ..	323	75	253	57	411	1,119	1,103	2,222
1926, July ..	345	120	321	143	1,544	2,473	1,185	3,658
1927, July ..	533	143	295	66	2,392	3,429	1,283	4,712
1928, July ..	465	98	239	88	1,648	2,538	1,035	3,573
1929, July ..	510	150	449	197	1,677	2,983	1,260	4,243
1930, January ..	585	270	346	202	3,403	4,806	1,335	6,141
February ..	570	270	331	183	3,677	5,031	—	—
March ..	555	187	330	172	3,937	5,181	—	—
April ..	450	218	336	149	3,984	5 137	—	—
May ..	435	188	449	279	3,931	5,282	—	—
June ..	375	188	507	269	3,769	5,108	—	—
July ..	353	135	483	245	3,616	4,834	1,297	6,131
August ..	285	120	435	243	3,457	4,540	—	—
September ..	270	120	399	234	3,622	4,645	—	—
October ..	353	270	376	215	4,327	5,541	—	—
November ..	525	255	374	165	4,875	6,194	—	—
December ..	623	278	351	147	5,264	6,663	—	—
1931, January ..	630	293	334	129	5,349	6,735	1,185	7,920
February ..	660	255	304	135	5,202	6,556	—	—
March ..	623	210	292	116	5,199	6,440	—	—
April ..	570	225	276	122	5,003	6,216	—	—
May ..	525	218	252	124	4,816	5,935	—	—
June ..	510	165	232	118	4,716	5,741	—	—
July ..	600	165	212	108	4,456	5,541	1,418	6,959
August ..	578	173	196	102	4,119	5,248	—	—
September ..	525	165	186	98	4,143	5,117	—	—
October ..	570	218	174	87	4,853	5,902	—	—
November ..	795	218	161	76	5,611	6,861	—	—
December ..	915	240	155	67	5,641	7,018	—	—
1932, January ..	1,013	248	145	63	5,521	6,990	1,447	8,437
February ..	1,043	405	155	60	5,195	6,858	—	—
March ..	1,065	278	141	57	5,007	6,548	—	—
April ..	1,050	195	138	60	4,720	6,163	—	—
May ..	1,013	203	144	134	4,536	6,030	—	—
June ..	915	232	153	157	4,047	5,504	—	—
July ..	885	203	161	179	3,780	5,208	1,553	6,761
August ..	878	210	169	166	3,283	4,706	—	—
September ..	795	188	167	169	3,288	4,607	—	—
October ..	742	225	159	154	3,779	5,059	—	—
November ..	773	240			4,176			

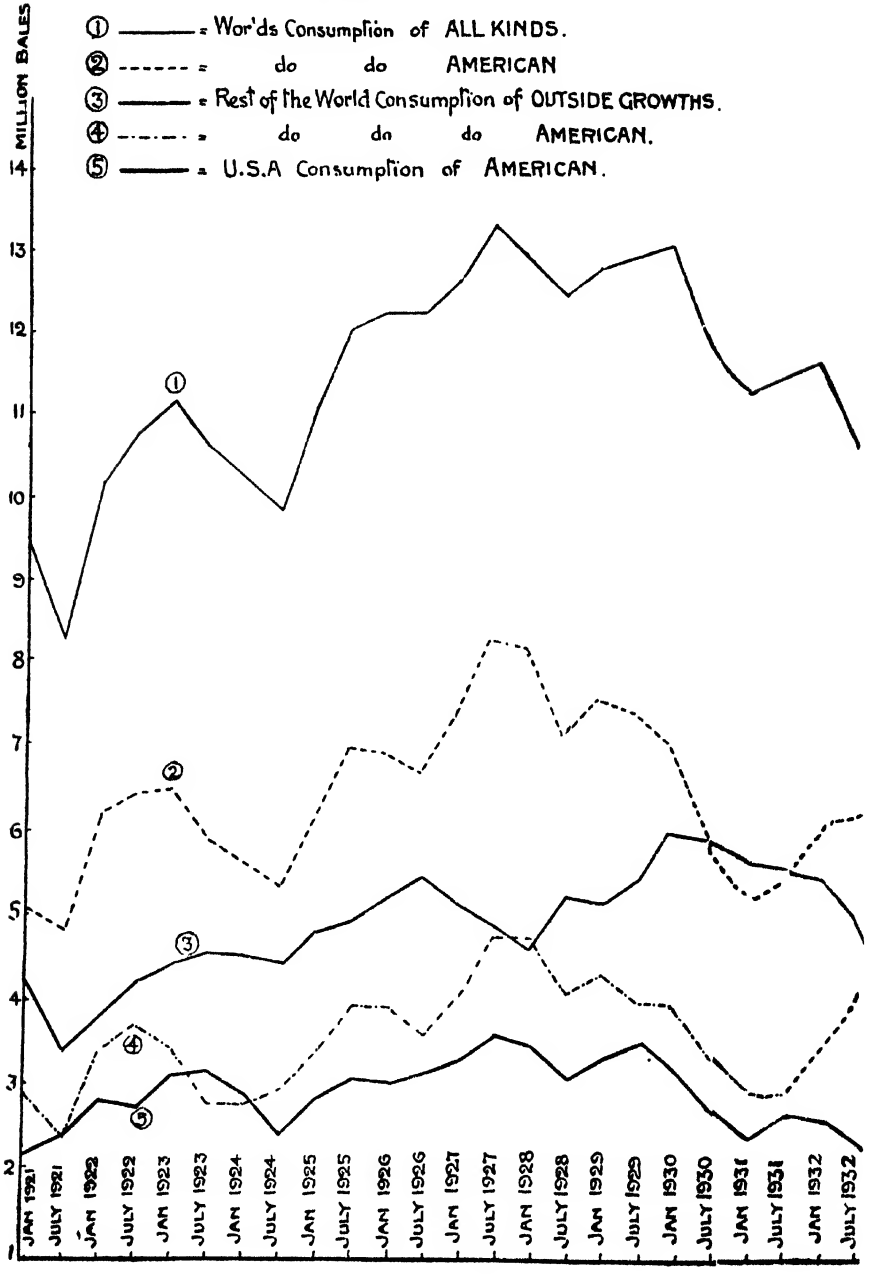
* Total foreign—details not given.

† Excluding Sudan cotton in Liverpool since 1924.

WORLD'S COTTON CONSUMPTION.

U.S.A. v. THE REST OF THE WORLD

AMERICAN v. OUTSIDE GROWTHS



NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. Bombay. We have to extend a welcome to a new journal, the *Journal of the University of Bombay*, which is mainly intended to promote research work by the teachers and students of the University of Bombay. It will contain original articles, abstracts of theses, and reviews of books, and will be issued six times a year, the issues being devoted to the following subjects in their order: No. 1. History, Economics, and Sociology (July); No. 2. Physical Sciences, including Mathematics (September); No. 3. Arts and Law (November); No. 4. History, Economics, and Sociology (January); No. 5. Biological Sciences, including Medicine (March); No. 6. Arts and Law (May). It is published by Longmans Green and Co., Ltd., Bombay, and the annual subscription is Rs. 14.

2. The Hand Weaving Industry, Bombay. (*Text. Rec.*, l., **595**, 1932, p. 64.) The Director of Industries, Bombay, has proposed that a cess of about three pies per lb. of yarn should be levied on the Indian mills' yarn production for the benefit of the hand loom industry. By this means, a sum of about Rs. 80 lakhs would be raised which could be utilized for the purpose of organizing co-operative societies, for imparting technical education, for giving financial help to hand loom weavers, and for improved marketing of their production.

3. Indian Central Cotton Committee. The Committee have opened a Publicity Bureau with a view to bringing before the notice of people overseas, through the medium of newspaper and magazine columns, the results achieved in the course of important investigations connected with cotton problems. It is hoped by means of publicity to further the aims and objects of the Committee, and to benefit its constituents, the cultivator, consumer, and exporter of cotton.

We have received from the Publicity Officer the following notices: Spinning Tests of Commercial Indian Cottons; Improvement of cotton cultivation in the Punjab; The terrible bollworm: how to eradicate the pest; Cotton cultivation under the Lloyd Barrage Canals; Fighting the ravages of wilt; Use of long staple cotton by Indian mills; Protection for the grower of long staple Indian cotton against the influx of foreign cottons. The papers should be of much interest to all who are concerned with Indian cottons, but they are too long for inclusion in these notes.

4. Spinning Test Reports on Indian Cottons. By N. Ahmad. (*Ind. Cent. Cot. Comm. Tech. Circs., Nos.* 77-80, 1931-32.) The circulars contain the grader's report and spinning test results for Bijapur, Tinnevelly, Upland, Cambodia, Karunganni, Kadi-Viramgam, Khandesh, Kalagin, and Bagalkote cottons for the 1931-32 season.

5. Technological Reports on Standard Indian Cottons, 1932. By N. Ahmad. (*Tech. Bull.*, Ser. A., No. 21, 1932. Indian Central Cotton Committee.) The reports contain the results of tests on standard cottons of the nine seasons 1923-32. As in former years the Agricultural Details, Grader's Reports, Fibre Particulars, Spinning Tests Reports, and Remarks are given for each of the eighteen standard Indian cottons. This year three cottons—one each from Bombay, Madras, and the United Provinces—have been deleted from the list. The Bombay cotton, Dharwar, has been almost completely replaced by Jayawant, which, with an equal spinning performance, is much less susceptible to wilt. ' The

Madras cotton, Cambodia Co. 1, has been superseded by Cambodia Co. 2, which is equally good in spinning, and has on the whole given a higher yield per acre. The U.P. cotton, J.N. 1, failed to find favour with cultivators, and has gone out of general cultivation.

Of the eighteen cottons tested, four have shown improvement, two have remained stationary, and twelve have suffered setback. Wagad 8 showed the greatest improvement, followed in less degree by Verum Akola, Jayawant, and Surat 1027 A.L.F. The two Hagari cottons, which showed remarkable improvement last season, have failed to keep it up this season, although the results are still better than those obtained in 1929-30.

6. INDIAN COTTON INDUSTRY: CASE FOR PROTECTION. (*Text. Merc.*, **87**, 1932, p. 59. Abstr. from *Summ. of Curr. Lit.*, xii., **16**, 1932, p. 476.) Some of the principal arguments put forward by Indian millowners in support of the case for increased protection against imported yarns and piece goods are outlined. The report of the Ahmedabad Millowners' Association deals with the efforts made by Indian mills since 1927 to spin yarn in medium and fine counts. The report of the Bombay Millowners' Association is concerned mainly with Japanese competition.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

7. The following reports have recently been received:

ROTHAMSTED EXPERIMENTAL STATION: Rpt. for 1931.
BRITISH GUIANA: Adm. Rpt. of Dir. of Agr., 1931.
FIJI: Ann. Bull. of Divisional Rpts., 1931.
GAMBIA: Ann. Rpt. of Dpt. of Agr., 1931-32.
KENYA COLONY: Agr. Census, 1932. Ann. Rpt. of Dpt. of Agr., 1931.
NYASALAND: Ann. Rpt. of Dpt. of Agr., 1931.
SOUTH AFRICA: Official Year Book, 1930-31.
SUDAN: Ann. Rpt. of Comm. Intell. Branch, Cent. Econ. Bd., 1931-32.
Rpt. of Govt. Entomologist, 1930.
Rpt. of Govt. Entomologist, 1931.
UGANDA: Ann. Rpt. of Dpt. of Agr., 1931, Pt. I.
WEST INDIES: *Barbados.* Agr. Jour., 1932, Vol. I., No. 2.
Montserrat. Rpt. of Agr. Dpt., 1929-31.
St. Kitts. Rpt. of Agr. Dpt., 1931.
St. Lucia. Rpt. of Agr. Dpt., 1931.
St. Vincent. Rpt. of Agr. Dpt., 1931.

8. ROTHAMSTED EXPERIMENTAL STATION. The Report for 1931 describes among other matters the work carried out in connection with the following:—(1) The most efficient use of artificial fertilizers on grass and arable land. (2) The maintenance of soil fertility in regions where mechanization is advancing and livestock is being reduced.

Summaries are included in the report of 102 papers published in various scientific journals in 1931. The library continues to expand, and now contains some 23,000 volumes. During the year a new block of buildings was erected, containing the demonstration room, workrooms for the experimental staff, and office and store-rooms. The cost of £1,300 was defrayed by public subscription.

9. THE PROGRESS AND DEVELOPMENT OF COTTON GROWING WITHIN THE BRITISH EMPIRE. By Sir William Himbury. (*Cotton*, M/c., xxxviii., **1838**, 1932, p. 25.)

A very useful and interesting report, including a statistical table giving areas, population, suitability of soil, estimates of 1931 crop, and quality, for all the cotton-growing colonies, followed by a discussion of the individual cases.

10. ASIA: CEYLON. *Cotton Cultivation*, 1931. (*Adm. Rpt. of Dir. of Agr.*, 1931, received 1932.) The attempt to establish cotton cultivation has been unfortunate in having to experience a regular fall in prices since the work started. Considerable work has been done in finding the most suitable variety to grow, and the best way to grow it under local conditions, and a large measure of success has been obtained.

In the Hambantota district, cotton is the main money crop as long as prices are good, and if fair yields are obtained, even at the present low prices it can still be regarded as remunerative. It is suggested that cotton, kurakkan, maize, green gram, chillies, and gingelly should be included in a suitable rotation, so that they may be continuously cultivated and good yields maintained. The cotton grown under the peasant scheme was purchased by the Ceylon Spinning and Weaving Mills at Rs. 10 per cwt. of seed cotton. Cotton competitions were held as usual for cultivators in the district, the Ceylon Spinning and Weaving Mills again meeting the cost of the prizes, which were given in the form of implements instead of gold medals. Five first prizes of Meston ploughs, two second prizes of Guntaka harrows, and one second prize of a Molegoda plough were awarded.

In the Embilipitiya district the 1931 crop suffered severely from unseasonable rainfall and from the attacks of the leaf-rolling caterpillar, *Sylepta derogata*, with the result that the amount of cotton purchased was considerably less than in the previous year.

11. AFRICA: ECONOMIC CONDITIONS IN EAST AFRICA AND IN NORTHERN RHODESIA AND NYASALAND, 1930-32. By Col. W. H. Franklin and C. Kemp. (No. 526, 1932, *Dpt. of Overseas Trade.*) We have received a copy of this report from the Dpt. of Overseas Trade. Considerable attention is devoted to import trade and to the principal articles of export. The economic position in each Territory is discussed, together with questions of public finance, and particulars are included regarding railways, harbours, shipping, roads, and airways, together with statistics of trade and shipping.

12. GAMBIA. *Cotton Selection Work.* (*Ann. Rpt. of Dpt. of Agr.*, 1931-32.) During the season under review selection work was carried out with native cotton, and some Cambodia cotton, received from India, was grown for increase.

13. KENYA COLONY. *Cotton Buying and Ginning.* (*Agr. Census*, 1932. Statistics Branch, Dpt. of Agr., Kenya.) The following table gives returns of cotton buying and ginning for the seasons 1930-31 and 1931-32. The cotton is almost purely of "native" production:

	1930–31.	1931–32.
Total number of ginneries operating	3	4
Number of gins working	24	37
Total quantity of cotton purchased:		
"A" quality (lb.)	958,352	2,306,418
"B" quality (lb.)	33,654	440,882
Average buying price:		
"A" quality (cents per lb.)	9·82	9·57
"B" quality (cents per lb.)	4·00	3·66
Total quantity of cotton:		
Lint ginned, "A" quality (lb.)	308,857	676,586
"B" quality (lb.)	11,538	17,597

14. KENYA COLONY. *Cotton Industry*, 1930-32. (Abstr. from *Ann. Rpt. Dpt. of Agr.*, Kenya Colony, 1931.) *Nyanza Province.*—The 1930-31 cotton crop was a small one, but as natives have now realized the necessity for greater care in picking and sorting, the quality showed a great improvement. The opening prices paid were Sh. 7 per 100 lb. at stores and Sh. 8 at ginneries. These were discouraging, and it is believed that a fair amount of cotton was taken across the border to Uganda, where prices were slightly better. Prices improved later to Sh. 10 and Sh. 12 respectively.

In 1931-32, in spite of much of the time of Administrative and Agricultural Officers being occupied with locust destruction, an intensive campaign was made for extending the acreage under cotton, and 162 tons of seed were issued for planting. The spacing of plants was improved by the use of spacing sticks. Weather conditions were good and the crop exceeded that of the previous season.

Coast Province.—Owing to the inadequate rainfall, the yield in the 1930-31 season was only 29,500 lb. of seed cotton, as compared with 510,500 and 202,700 lb. respectively for the two previous seasons. Buying opened at Sh. 7 per 100 lb. for first quality seed cotton, but improved later to Sh. 8.

In the 1931-32 season meetings were held with a view to bringing before the notice of the natives the necessity for earlier cutting out of old plants and earlier planting of the new crop in order to obtain better crops. As the local type of seed had degenerated somewhat 3 tons of the N.17 variety were obtained from Uganda, and issued at Malindi and Ganda for trial, with the object of bulking the seed and replacing local strains if results proved satisfactory. In addition, a trial of another Uganda variety, S.G.29, was begun at Kibarini. This is very definitely superior to the local type, and work will be continued on it. The season was a good one, and very satisfactory yields of seed cotton were obtained. Buying opened at Sh. 7 per 100 lb. of seed cotton of first grade, and later rose to Sh. 8. The price for second grade cotton was Sh. 4. Satisfactory features of the crop were the small proportion of second grade cotton, steady improvement in cultural methods, and the adoption of early planting.

15. *Cotton Prospects.* (*Econ. Condns. in E. Afr. and in N. Rhod. and Nyasaland*, 1930-32.) Climatic conditions and lateness of the crop in 1931 resulted in a poor yield. The prospects for 1932 are believed to be much better and an increased crop is foreshadowed.

16. NIGERIA. *Cotton Investigations.* (*Bull. of Imp. Inst.*, XXX., **3**, 1932, p. 344.) From the report of the Botanical Section, Southern Provinces, for the first half-year, 1932, we learn that the major problem under investigation continues to be the elimination of roughness of lint from Ishan cotton. It has been necessary to retain the Ishan hybrid strains in the single-plant stage for another season. Parent plants chosen for smoothness of lint are judged not to be yet producing an even degree of smoothness in their progeny. In addition to the work with Ishan cotton, five strains of New Guinea Kidney by Sea Island backcrosses, made by Mr. Anson in Fiji, are under trial at Ibadan. The experiment commenced in 1929-30 on a single plot of about an acre, to test the value of growing a crop of mucuna before cotton, has been continued. The mucuna is sown in March with the first rains; the previous cotton crop is uprooted and burnt early in April; the mucuna is ridged in about the middle of June; and the cotton crop is sown early in July. The land is thus under continuous cropping and receives one ridging per annum. Improved Ishan Strain A has been grown since the experiment commenced. The annual yields of seed cotton for the plot were 807 lb. in 1929-30, 431 lb. in 1930-31, and 411 lb. in 1931-32. The 1929-30 season was an exceptionally favourable one. In the present season an early crop of

mucuna grown as green manure appears to be adequately maintaining fertility for the cotton crop.

The Agricultural Botanist, Northern Provinces, reports that Strain L is now being substituted for Strain D, which was found susceptible to jassid. L is not particularly hairy, but is not attacked by jassid to any great extent. The yield is not inferior to commercial Allen. Selection work has been continued with Kabba cotton, and several new strains of U.4 and two Uganda strains (S.G.27 and S.G.29) have been tried. The two Uganda strains appear promising.

17. NYASALAND. *Cotton Cultivation*, 1931. (*Ann. Rpt. of Dpt. of Agr.*, 1931.) The very unfavourable weather conditions experienced and the world slump in cotton prices depressed both the planting and the yield of native-grown cotton, which had been an expanding peasant industry until 1931. The effects of low prices are discussed in detail. The crop was again purchased by the British Cotton Growing Association, whose assistance was much appreciated.

The experimental work of the Corporation was continued at the experiment stations at Makwapala, Port Herald, and Domira Bay. The most promising variety of cotton grown was U.4, and much attention was given to the various aspects of its cultivation. In addition, spacing experiments, and studies of rotations, interplanting, soil conditions and their amelioration, were continued. In connection with the work of the Corporation the Director of Agriculture states that "this useful and practical work was continued in 1931. The full results of it will not be seen until the prevailing depression has passed away, but it is anticipated that they will be of great value when it is possible to replace the present policy of contraction by a policy of expansion."

18. *Cotton Cultivation*, 1932. (*Econ. Condns. in E. Afr. and in N. Rhod. and Nyasaland*, 1930-32.) Recent reports show that an acreage considerably larger than those of recent years has been sown by native growers in 1932, indicating a revival of interest in cotton cultivation.

19. *Crop Prospects.* The latest report received is to the effect that the crop in general is bearing heavily, and the quality is good.

20. THE SUDAN PLANTATIONS SYNDICATE. *Cotton Cultivation*, 1931-32. (*Times*, 4/11/32.) The season was a very successful one. 5,805 feddans at Zeidab produced at the rate of 4·14 kantars a feddan, while 174,788 feddans in the Gezira gave a crop of 4·03 kantars a feddan. This is attributed to favourable climatic conditions and to the steps taken to combat pests and diseases. Beginning with the 1933-34 season, it has been decided to introduce a four-year rotation which will allow of two fallows and the growth of food crops. Prospects are good for the coming season.

21. TANGANYIKA. *Cotton Experiments*, 1930. (*Ann. Rpt. of Dpt. of Agr.*, 1930, received 1932.) Describes the following experiments carried out at the various stations: Time of sowing and varietal trials at Morogoro; time of sowing, selection work with U.4 cottons at Ibadakuli; time of sowing, spacing, varietal trials, selection work, and yield trials at Mpanganya. At the Mpanganya Station the Mp. selections made by Mr. R. C. Wood (formerly of the Empire Cotton Growing Corporation) from ordinary district cotton, were continued for further trial and selection. Uniformity as regards habit of growth and period of maturity was lacking in all, but notwithstanding this lack of uniformity the quality of several of the Mp. selections was very notable.

22. *Cotton Cultivation*, 1931. (*Econ. Condns. in E. Afr. and in N. Rhod. and Nyasaland*, 1930-32.) The 1931 cotton crop proved very disappointing.

A considerable output was estimated, but adverse weather, destruction by rodents, and bad farming methods resulted in a yield of approximately 10,000 bales only. The outlook for 1932 has considerably improved, and the forthcoming crop is estimated at 21,000 bales.

23. UGANDA. *Cotton Cultivation*, 1931-32. (*Ann. Rpt. of Dpt. of Agr.*, 1931, Pt. 1, received 1932) The weather conditions were good up to the end of September, and there was every indication of a record crop. The heavy rains experienced in October and November, however, caused excessive vegetative growth and shedding of buds and bolls, with a consequent adverse effect on yield. An outstanding feature of the season was the wholesale invasion of the Protectorate by the Hairy-chested Locust (*Locusta migratorioides*), and an account is given of the measures that were taken to control the pest. Pink bollworm made its appearance for the first time, but at the time of writing indications were that the infestation was sparse.

In the Eastern Province a total acreage of 55,499 was planted with S.G.29 cotton, the latest strain to be introduced into general cultivation.

Ploughing continued to be popular in the Teso and Bugwere districts, and the increase of 1,426 ploughs in the former district was considered very satisfactory. In the Lango district also natives showed interest, but here lack of money was a limiting factor to progress. This was overcome to some extent by re-selling on credit, to suitable natives, ploughs bought by Native Administration funds.

The number of ginneries licensed to gin and bale cotton during the year was 127, as compared with 123 in 1930.

The Cotton (Tax) Ordinance was repealed in 1931, and was replaced by a Cotton Export Duty Ordinance. The basis of the tax was still the price of American Middling Cotton, but July futures in December were substituted for those of June. In addition, the scale of taxation was amended, the lowest value at which the tax became operative being 5·01d. as against 6·01d. in the previous Ordinance.

24. *Cotton Industry*, 1931-32. (*Econ. Condns. in E. Afr. and in N. Rhod. and Nyasaland*, 1930-32.) It was anticipated that the crop would be considerably over 200,000 bales, but owing to disease and adverse weather conditions a yield of 190,000 bales is now estimated. In many districts of the Eastern Province the reduction in yield as compared with the preceding season has been as much as 50 per cent., but in Buganda the increase in the crop reached a similar percentage, and some 80,000 bales are expected. The use of ploughs, which allows the individual grower to handle about 50 per cent. more land, is increasing. Ploughed areas, however, according to existing records, give smaller yields than those cultivated by hand, and it is regarded as essential that, in the case of a native who ploughs his land, a small cultivator should also be used in order to obtain what is considered to be a reasonable yield of 500 to 600 lb. of seed cotton per acre. No further steps have been taken to re-establish buying associations of ginners.

25. *Cotton Prospects*, 1932-33. The latest report received from the Dept. of Agriculture stated that at the end of September the acreage planted in all Provinces was estimated to total 1,044,897, an increase of 179,638 acres over the previous season's total. Reports of localized insect damage had been received, and in Teso District the initial stages of blackarm were found in many areas. In general, the condition of the crop was normal in all districts.

26. AUSTRALIA. *Cotton Bounty*. (*Int. Cott. Bull.*, x., **40**, 1932, p. 593.) According to reports from Australia, at a Federal Cabinet Meeting in Sydney it

was decided to abolish the cotton-yarn bounty from July 1, in order to relieve the Government of an annual payment of £120,000. The industry will be protected by Customs duty alone. Fixed-rate duties have been imposed on a sliding scale, and in effect will be equivalent to the cancelled bounty on the various types of yarn. A minimum price of 9¼d. per lb. will be paid to the Queensland Cotton Board for the 1932 season's raw cotton. The cotton bounty was to have been paid until 1936, but the Government considers that sufficient protection can be afforded by Customs duties.

27. QUEENSLAND. *Cotton Cultivation*, 1931-32. (*Dalgety's Ann. Wool. Rev.*, 1931-32, p. 160.) The extremely dry weather conditions prevailing in the cotton-growing districts of the State from the middle of December to early in April ruined all prospects of a profitable cotton yield, and the season was the worst experienced since the industry was started in 1919. The production will fall far short of Australian spinners' requirements, and cotton will have to be imported to make up the deficiency.

28. FIJI. *Report on the Cotton Experimental Station, Sigatoka*, 1931. (*Ann. Bull. of Div. Rpts.*, 1931, recently received.) The Cotton Specialist, Mr. Anson, reports that during the year, in addition to the experiments carried out with the major crop, cotton, work in connection with minor crops was considerably expanded. The supervision of the Fijian Agricultural Scheme was handed over to the Cotton Station in August. This added greatly to the work of the staff, but it was anticipated that the arrangement would prove mutually satisfactory, since the areas of land cultivated by the Fijians under instruction from the Station would offer an excellent opportunity for isolating increased plots of pure line seed which had been bred up at the Station, while the Station would be invaluable to the Fijian agricultural centres as a source from which pure line acclimatized seed might be obtained without delay.

The outstanding feature of the season was the exceptional flood which occurred on February 22, when the whole Station was covered for twelve hours with six to seven feet of water, which caused severe damage to crops and rendered many experiments practically useless. Most of the valuable plants were saved, however, but the work was put back twelve months.

The report also contains accounts of manurial trials and of breeding experiments. Particular attention was paid to yield and fineness of staple, with the object of obtaining from the selections a cotton suitable for selling against Egyptian, and for which there would be a more consistent demand and wider market than is the case with Sea Island cotton.

Spinning tests were made on the New Guinea and Sea Island backcross, and the cottons were reported as running well, and less neppy but weaker than the control. The colour was considered good, but the cottons were not considered a commercial proposition for counts finer than 150's mule. The brokers valued the cottons at 12d. against Extra Fine Sakel at 13·50d.

29. WEST INDIES. BARBADOS. *Cotton Cultivation.* (*Agr. J. of Dpt. of Sci. and Agr. Barbados*, vol. i., No. 2, 1932.) The drought of 1930 enabled cotton planters to secure a heavy crop of high quality Sea Island cotton. The new closer spacing advocated by the Department proved extremely beneficial, and the 2,845 acres under cultivation produced 340,450 lb. of lint. The low prices obtained for the crop, however, and the small demand for Sea Island cotton, resulted in a much reduced acreage being planted in 1931. This is a serious matter for Barbados, as, in addition to being a most excellent rotation crop with sugar, cotton has proved an extremely valuable cash crop for peasant cultivators.

In spite of a fourteen months' close season in 1928-29 and the very thorough

uprooting and destruction of cotton residues in the two succeeding years, the pink bollworm has made its reappearance in the island in increasing numbers, though nowhere sufficiently great to cause economic loss.

During the 1931-32 season 3,030 bags of imported cotton seed were disinfected in the Simon's heater under the supervision of an inspector, and three ships were fumigated with Zyklo- B.

30. MONTSERRAT. *Cotton Cultivation*, 1929-31. (*Rpt. on the Agr. Dpt. Montserrat*, 1929-31, recently received.) The following summary is given of cotton cultivation in the island during the three years under review: 1929.—The year was one of high rainfall and free from any abnormal or atmospheric disturbances. The heavy rains experienced were responsible for the general restoration of the vegetation of the island, so badly damaged by the storm of 1928. Cotton was again the principal crop grown, 3,200 acres being planted, the production from which was 726,159 lb. of lint, which constituted a record. Apart from isolated attacks of the cotton worm (*Alabama argillacea*) and the bacterial boll disease, the damage by pests and diseases was negligible. Pink bollworm did no material injury.

1930.—During this year 4,079 acres were planted to cotton. The yield of lint was 737,719 lb. or an average of 181 lb. per acre. Due to the depressed condition of the market for Sea Island cotton, growers were advised by the Department of Agriculture to restrict their areas during 1931.

1931.—This year proved one of heavy rainfall, but the distribution was not favourable for the normal development of the cotton crop. The low rainfall at the sowing period caused irregular stands in the cotton-fields, and an abnormal, heavy precipitation at the bolling period proved a serious limiting factor to production. The area planted was 3,425 acres, from which 400,389 lb. of lint were produced. The yield per acre was, therefore, at the rate of 117 lb. lint, which is below the average. The cotton leaf-worm and the pink bollworm were very much in evidence, and were also responsible for the low yields. During the year the new Cotton Seed Control Ordinance was brought into force.

The report also describes the work carried out in connection with seed selection, spacing, seed inspection, and cotton pests. Dr. Harland visited the island in November, 1930, to investigate the alleged falling-off in the purity of Montserrat cotton. It was found that while a very considerable amount of off-type cotton was grown in certain districts, the source of supply was still pure. Certain recommendations made by Dr. Harland were put into practice, with satisfactory results, and the visit is stated to have been of great value to the cotton industry of the island.

31. ST. KITTS-NEVIS. *Cotton Cultivation*, 1931. (*Rpt. on Agr. Dpt.*, 1931.) The unsatisfactory conditions ruling in the Sea Island market caused less acreage to be planted to cotton in St. Kitts. The yield was a poor one, owing to unfavourable weather conditions and to attacks of pink bollworm and cotton leaf worm. Pink bollworm was also prevalent in Anguilla. The crop of Nevis showed excellent promise until late in the season, when attacks of pink bollworm destroyed all prospects of a good yield. The purchase of peasants' cotton on a co-operative basis was started by the Government in Nevis in April, 1931. An advance of 5 cents per lb. was paid on delivery of the cotton, and only clean Sea Island was received. The lint was shipped to the British Cotton Growing Association, and was sold at a price which allowed a bonus of 1·836 cents per lb. to the peasants. The Government also acquired the ginnery of the Fine Spinners, and it is felt that this will be of much benefit to the industry.

At the Government Seed Farm selection work was continued, but the yield

of cotton was low as a result of severe attacks by the cotton leaf-worm, early infestation with pink bollworm, and heavy rainfall when the crop was maturing.

32. ST. VINCENT. *Cotton Cultivation*, 1931-32. (*Rpt. on the Agr. Dpt.*, 1931.) The area planted to cotton in the 1931-32 season was 1,754 acres under Sea Island and 886 acres under Marie Galante, totalling 2,640 acres. This was considerably less than the previous season, owing to the low prices ruling and to the small demand for Sea Island cotton. It is estimated that the yield will also be less, since very heavy rains were experienced, which resulted in some of the young plants being washed out of the ground and the soil waterlogged for some considerable time. In such circumstances weeding operations became difficult and were not efficiently carried out. No material damage was caused to the crop by insect pests.

Brief accounts are included of the experimental work carried out at the Cotton Experiment Station in connection with the breeding and propagation of a standard strain of superfine Sea Island cotton, the production of strains resistant to angular leafspot and to shedding, and hybridization experiments. The full report of this work, written by Dr. Harland and Mr. Evelyn, will be included in the *Reports from Experiment Stations*, 1931-32, published by the Corporation early in 1933.

33. *Cotton Cultivation*, 1932-33. The latest report received from the Dept. of Agriculture states that a smaller acreage has been planted to cotton for the 1932-33 season. Planting commenced on September 1, after a close season of four months. Germination of the seed has been good, although the weather was somewhat dry.

COTTON IN EGYPT.

34. MAARAD COTTON: CHARACTERISTICS. (*Revue Text.*, **30**, 1932, p. 671. Abstr. from *Summ. of Curr. Lit.*, xii., **19**, 1932, p. 533.) Maarad cotton has been developed from Pima cotton by the Egyptian Royal Society of Agriculture. This society controls the selection and distribution of the seed and supervises the cultivation and ginning of the cotton. Maarad cotton is about 3 mm. longer than Sakel in staple. The colour is slightly creamy, but is gradually approaching that of Sakel. The yield is 25-50 per cent. greater than that of Sakel, and the plant is more resistant to wilt disease and less subject to bollworm attack. Tests made in 1928 on 100's yarn spun from Maarad cotton and from Sakel cotton showed that the former gave the stronger yarn.

35. MOISTURE TESTS ON EGYPTIAN COTTON. By N. S. Pearce. (*Int. Cot. Bull.* x., **40**, 1932, p. 539.) Results are given of determinations of the moisture content of Egyptian cotton in various European countries. The tables include the results of 854 tests of which reports have been received since January 16, 1931. The present average moisture content is 8·899 per cent.

36. A PRELIMINARY NOTE ON THE PHYSIOLOGICAL AND GENETIC ASPECTS OF HAIR PROPERTIES IN EGYPTIAN COTTONS. By C. H. Brown *et al.* (*Tech. and Sci. Serv. Bull., No.* 123, *Min. of Agr., Egypt*, 1932.) The paper brings forward a series of comparisons between related strains or strains of similar type showing an improvement in hair properties from previously propagated strains to those under propagation now, and also showing the existence of material suitable for further selection with regard to hair properties. The environmental range found between samples of different seasons or from different localities in the case of any one strain is generally wider than the differences on which selection is based. This shows the necessity for making all such comparisons on such comparable samples as are only obtainable from chequer-plot material, in exactly the same

way as is now done by all workers looking for small yield differences between strains. The fact that in many cases strains with better hair properties are selectable from bulks which in other points are of established purity shows that the apparent homogeneity of any type does not always survive newer and more delicate methods of examination. The new selection method of the comparative examination for hair properties of material of single-plant origin has therefore a value when older methods of selection are not able to detect further differences.

COTTON IN THE UNITED STATES.

37. American Textile Notes. By W. Whittam. (*Text. Rec.*, l., **595**, 1932, p. 62.) The present position of the cotton industry, the plight of the cotton grower, and the activities of the Farm Board, are briefly discussed. An encouraging factor is that exports during the first seven months of the year were 40 per cent. above those for the like period of 1931. It is also estimated that 6,000,000 or more bales will be required to replenish depleted stocks of cotton products.

38. American Cotton in 1931-32. By G. W. Fooshe. (*Man. Guard. Coml. World Textiles Supplement*, October, 1932, p. 5.) An interesting account of cotton in America during a season described by the author as " bristling with difficulties." The causes of the acute depression in the industry, and the measures taken which resulted in its recovery, are discussed.

39. Grade and Staple of the American Cotton Supply. By N. A. Olsen. (*Cotton*, M/c, xxxviii., **1838**, 1932, p. 29.) In response to a demand from growers and spinners for information regarding the quality as well as the amount of each year's American cotton crop, legislation was passed by Congress in 1927 directing the Department of Agriculture to make an estimate of the grades and staple lengths of cotton carried over on August 1 of each year, and of the cotton as ginned during each crop year. Funds were made available in 1928, and the work was entrusted to the Bureau of Agricultural Economics. A report is given of the work carried out by the Bureau during the four years.

40. American Cotton Crop, 1931: Quality. (*Text. World*, **82**, 1932, p. 68. Abstr. from *Summ. of Curr. Lit.*, xii., **17**, 1932, p. 489.) In view of continued reports of loss in breaking load of yarn spun from the American 1931 long staple crop a questionnaire was prepared and sent out to a large number of mills using cotton of 1-inch and longer staple. Data showing comparisons of the quantity of waste and the breaking strength of yarn from the 1930 and 1931 crops are reproduced. The data indicate that the 1931 Delta crop was inferior in strength as compared with former years, whereas the 1931 Carolina crop showed a decided improvement in strength. The spinning qualities of the Delta crop did not decline in proportion to the decrease in strength. Only 34 per cent. of the users of Delta cotton reported a decline in running qualities of 1 to 5 per cent., while 12 per cent. of those mills reported a 6 to 10 per cent. decline. Other answers indicated that the Delta cotton was smooth and soft in appearance and feel, and showed some improvement in appearance, but there was more unevenness than usual. It was thought that immature fibres, resulting from premature opening of the cotton, were the principal cause of the decrease in strength of the 1931 Delta crop. This was evidently due to weather conditions prevailing during the picking season. Changes made by spinners in attempts to overcome defects due to inferior quality are indicated.

41. Staple Lengths of Foreign Cottons Consumed in United States. By P. M. Strand. (*Int. Cott. Bull.*, x., **40**, 1932, p. 585.) Great decrease is

shown in the quantity imported during the four cotton years ended July 31, 1931. The longer staples have suffered the most.

42. Progress of the New Crop. By C. T. Revere. (*Man. Guard. Coml., World Textiles Supplement*, October 1, 1932.) The author states that this year there has been a fairly substantial cut in acreage, a drastic reduction in the use of fertilizers, an abnormal increase in weevil infestation and damage, and decidedly adverse weather conditions.

43. Alabama. *Factors Related to Income and Costs of Production on Farms in Marshall and Dekalb Counties*, 1927-29. By C. G. Garman. (*Bull.* 236. *Agr. Exp. Sta., Alabama*, 1932.) The principal costs involved in producing cotton amounted to an average of $45 per acre during the two years 1928 and 1929. Man labour made up an average of 40·9 per cent. of this cost, fertilizer 21·3 per cent., use of land 12·1 per cent., and mule labour 8·3 per cent. The average cost of producing a pound of lint cotton was 9·4 cents in 1928 and 10·7 cents in 1929, or an average of 10·0 cents for the two years.

44. Arizona. *Irrigation and Related Cultural Practices with Cotton in the Salt River Valley.* By S. H. Hastings. (*U.S. Dpt. Agr. Circ.*, 200, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **2**, 1932. p. 128.) An informative discussion on the irrigation needs of cotton and methods of applying the water, and associated cultural methods and field practices for the crop in the Salt River Valley, is presented, with comments on climatic and agricultural conditions in the region, the reaction of the plant to unfavourable growth conditions, the accumulation of salts from continued irrigation and its control by leaching, alfalfa as an aid to irrigation of cotton, and the relation of soil moisture conditions to shedding and the " crazy top " disease.

45. Arkansas. *Cotton Experiments*, 1931-32. (*Forty-Fourth Ann. Rpt. Agr. Exp. Sta. Arkansas*, 1932.) Describes cotton breeding, spacing, varietal, and fertilizer experiments, selection for protein and oil content, and fibre investigations. In the cotton breeding experiment concerned with the inheritance of lint colours in Upland cotton, it was found that each of the four shades of lint (rust, dingy brown, yellowish brown, and green) studied was an incomplete dominant over pure white. Each was a clear-cut monohybrid character.

The results of studies in connection with cotton machinery indicated that all operations in the production of cotton, except hoeing and picking, can be accomplished with approximately 8 man-hours of labour per acre by the use of the tractor and large machine units. The use of a mechanical chopper effected a reduction of 5·85 man-hours of labour per acre, or a saving of about 29 per cent. in time. The use of large machines and mechanical power units did not cause a decrease in stand or in yield, in comparison with small mule-operated machines.

46. Carolina Cotton: Use for Tyre Cords. (*Cotton* (U.S.), xcvi., **5**, 1932, p. 52. Abstr. from *Jour. of Text. Inst.*, xxiii., **8**, 1932, A423.) Certain Carolina cotton from the last crop has shown sufficient improvement in quality to warrant its use in the manufacture of tyre cords, and a quantity of the cotton has already been purchased for this purpose by the Goodrich Company.

47. Florida. *Cotton Investigations.* (*Rpt. of Agr. Exp. Sta.*, 1931, recently received.) During the year the breeding, spacing, time of planting, and fertilizer experiments, varietal trials, and inheritance studies were continued, together with investigations on boll weevil control.

48. Georgia. *Cotton Variety Tests*, 1931. By H. K. Brabham. (*Ga. Sta. Circ.* 100, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **2**, 1932. p. 127.) The most successful varieties were D. and P.L. No. 8, Half-and-Half, Deltatype 9, Missdell 1,

Cleveland 884, and the wilt resistants Lightning Express, Rhyne-Cook, and Clevewilt.

49. Mississippi. *Field Crop Experiments at the South Mississippi Sub-Station*, 1931. By J. C. Robert *et al.* (*Miss. Sta. Bull.*, 297, 1931. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 29.) Fertilizer experiments with cotton dealt with carriers of nitrogen, potassium, and phosphorus, and comparisons of high and low analysis, factory *v.* home mixed fertilizers, and of various formulas.

50. *Report of the Holly Springs Branch Experiment Station*, 1931. By O. B. Casanova. (*Miss. Sta. Bull.* 296, 1931. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 28.) Field crop experiments included variety tests with cotton and corn; fertilizer trials with cotton, including comparisons of sources of nitrogen, phosphorus, and potassium; and comparison of the effect of crop rotation *v.* continuous cotton upon soil fertility.

51. Cotton Investigations. By J. C. Overpeck and W. T. Conway. (*New Mexico Sta. Bull.*, 201, 1932. Abstr. from *Exp. Sta. Rec.*, 67, **4**, 1932, p. 380.) Variously spaced plants differed little in acre yield, the usual method, one plant 10 to 12 in. apart, being as good as any other spacing. Topping (removing the terminal buds) the plants to check vegetative growth did not increase yields, but often depressed them. The shrinkage loss of cotton seed piled in the open for a few months amounted to 5·5 per cent., and that stored under a dry shelter 1·2 per cent. Neither nitrogen nor phosphorus fertilizers appeared to return increased yields on heavy, fertile soils, although there were indications that such treatment might give higher yields on light soils and on fields continuously cropped to cotton for several years. Manure increased yields and appeared to delay maturity somewhat.

52. Texas. *Agronomic Work of the Big Spring Field Station*, 1915-29. By F. E. Keating. (*U.S. Dpt. of Agr. Circ.* 202, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 30.) Contains reports on rotation and tillage experiments and variety and planting tests carried out to determine the possibilities and best methods of crop production. Cotton is indicated as the principal cash crop, the most suitable varieties for the region being Mebane, Lone Star, and Acala.

COTTON IN FOREIGN COUNTRIES.

53. The Chinese Cotton Industry. By T. Hwang. (*Chin. Econ. Jour.*, April, 1932. Abstr. from *Int. Cott. Bull.*, x., **40**, 1932, p. 579.) The development of cotton mills in China during the ten years 1922-31 has been rapid. In 1922 there were 116 mills with 1,069,756 spindles and 3,969 looms, and in 1931, 130 mills, with 4,497,902 spindles and 33,580 looms. From these figures it will be seen that the number of spindles increased more than four times and looms almost ten times within the decade. The amount of cotton consumed was 4,690,000 piculs in 1922, and 9,230,356 piculs in 1929, but the output of Chinese cotton actually decreased, being 8,310,355 piculs in 1922, against 7,586,958 piculs in 1929, thus giving foreign cotton an opportunity to secure a strong hold in the Chinese market.

In regard to the native cotton-growing industry, it is stated that growers have not done what they might to improve this. The grades of cotton offered for sale show that inferiority of quality and shortness of staple which hinder the expansion of trade, and in addition to the antiquated methods of cultivation there is the disastrous effect of the dishonest practices of watering and otherwise weighting cotton. In order to check deterioration in the standard of Chinese cotton and revive the industry Government has established experiment stations

to carry on research work in regard to seed improvement. Regulations and laws have been promulgated for the purpose of checking adulteration and to encourage the planting of superior qualities of cotton, but, largely owing to political changes, little progress has been recorded.

The fact that Chinese cotton still holds a fairly good position on the international market is largely due to the precautionary measures taken by the Bureau of Testing and Inspection of Commercial Commodities. No export or import of cotton is permitted without examination by this Bureau.

54. Association Cotonnière Coloniale. *Bull. No.* 8, contains the following articles: "La situation des principales branches de l'économie nationale" by W. Oualid, dealing with the cotton and wool industries; "La culture du coton. Comment sera aménagée la vallée du Niger" by P. Jourain; and two short papers dealing with cotton culture in Morocco. The usual notes on cotton in the French Colonies, cotton legislation, etc., are included.

55. La Culture Cotonnière dans l'Afrique Équatoriale Française. By W. J. Lugard. (*Coton et Cult. Coton*, vii., 1932, p. 17.) An account of the development of cotton cultivation in French Equatorial Africa. The country has been divided up into zones in which four societies are privileged to operate. Population figures for the various districts are included. Comparative tests of several varieties of cotton from America with Triumph cotton from the Belgian Congo are discussed.

56. Persia. *New Textile Mills.* (*Int. Cott. Bull.*, x., **40**, 1932, p. 593.) A report from the U.S. Department of Commerce states that several new textile mills were constructed during 1931 and others were contemplated. The investment of local capital in textile manufacture was encouraged by the legal requirement that all Government officials should wear clothes made from native fabrics, and by restriction on imports. The spinning mill constructed at Aliahad under the patronage of the Shah and the National Bank of Persia planned to begin operations in January next.

57. Étude Technologique d'un Coton de Perse: "Philestan." By Heim de Balsac and Roehrich. (*Coton et Cult. Coton*, vii., 1932, p. 33.) Philestan cotton has a staple length slightly less than that of Sakel, but greater than that of most Upper Egyptian cottons. Its general homogeneity is rather low. The cotton is not so fine as Sakel but is finer than most Egyptian varieties. The coefficient of maturation is good. The tensile strength is rather less than would be expected from the maturation. It is capable of being spun beyond 100's.

58. Russia. *Cotton Cultivation.* The following articles dealing with cotton cultivation in the U.S.S.R. are included in the *Bull. of App. Botany, Genetics and Plant Breeding*, xxvi., 1931, a copy of which has been received. They are in Russian and contain no English summaries: "The possible climatic limits of cotton growing in the European part of U.S.S.R." by G. T. Selyaninov; "Chief diseases and insect pests of cotton in the new regions" by M. A. Ryabov; "Short survey of the soils of the new cotton-growing regions in the South and South-East of U.S.S.R." by L. I. Prassolov; "On the importance of agrotechnical measures improving the heat régime of the soil under cotton" by K. V. Flyorov; "Weeds of the Cotton Plant" by A. I. Malzev.

59. The Climate of the New Cotton Regions. By N. P. Zhuravskaia, A. D. Gedeonov and E. E. Federov. (*Bull. of App. Botany, Genetics and Plant Breeding*, xxvi., 1931, p. 231.) (In Russian, with an English summary.) Deals with the climate of the Crimea, North Caucasus, and the lower part of the River Volga.

60. Russian Cotton: Imports by Great Britain. (*Text. Weekly*, ix., 1932, p. 281. Abstr. from *Summ. of Curr. Lit.*, xii., **13**, 1932, p. 364.) Russian cotton has greatly complicated the long-staple market, and is an uncertain factor. In 1930, imports were 2,808,500 lb. of cotton of 1¼ in. staple and over, and 6,071,900 lb. of shorter cotton. The total soared to 88,558,700 lb. in 1931, but this year (1932) none is on offer.

61. Cotton Growing in Siam. (*Int. Rev. Agr.*, Rome, xxiii., **8**, 1932, p. 295.) The cotton plant has been cultivated in Siam from time immemorial, and there are in consequence a number of indigenous varieties. *Gossypium Nanking* var. *Siamensis*, with white or coloured bolls, is considered to be the original variety of cotton in Siam. It is very generally cultivated in the northern part of the country, and also in the south as far as the province of Kanburi. The Department of Agriculture has imported seed from Cambodia, India and Egypt, but unfortunately growers have made no effort to keep the seed pure. The present area under cotton is about 9,000 acres.

62. Étude Technologique d'une Série de Cotons de Syrie. (*Coton et Cult. Coton.*, vii., 1932, p. 25.) A technological study of thirteen Syrian cottons of the Texas Lone Star variety. The length variations were not great, and all the cottons had a good average tensile strength.

63. Cotton: Cultivation in Turkey. (*Revue Text.*, xxx., 1932, p. 591. Abstr. from *Summ. of Curr. Lit.*, xii., **17**, 1932, p. 477.) The soil of Turkey is suitable for cotton cultivation. The Government has established stations for seed selection, and is encouraging cultivation. An American cotton, Express variety, of staple length 26-28 mm. and spinning up to 40's, and a variety of American origin known as "secours" (iané), which has a staple length of 22-27 mm. and will spin to 24's, are grown. At present 80 per cent. of the crop is obtained from seed of the indigenous variety which is most resistant to the prevailing climatic conditions. This type of cotton cannot be spun beyond 24's; it is being replaced by other types of better quality.

SOILS AND MANURES.

64. A New Type of Hydrometer for the Mechanical Analysis of Soils. By A. N. Puri. (*Soil Sci.*, iv., **33**, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **3**, 1932, p. 212.) The instrument described in this contribution from the Irrigation Research Laboratory, Lahore, India, consists of a short bulb (6 to 8 cm. long) and a long thin stem (50 to 60 cm. long). The readings are taken with a special device accurate to the fraction of a millimetre. The tip of an ordinary pin attached to a thin brass cap fitting on the top of the hydrometer stem forms the reference point, and the readings are taken against the graduations on a burette tube held in a special clamp. The mouth of the burette tube is closed with a brass cap having a hole in the middle through which the hydrometer stem is passed. The edges of the hole are sharpened to prevent friction that might hinder the free movement of the hydrometer. The working of the instrument is explained.

65. The Mitscherlich, Wiessmann and Neubauer Methods of determining the Nutrient Content of Soils. By R. Stewart. (*Tech. Commn., No.* 25, Imperial Bureau of Soil Science, 1932.) This review of methods for the determination of the manurial content of soils deals with a particular section of the work carried out on the general problem of available soil nutrients and their determination, and refers to those methods in which plants are used.

66. Cotton Plant Fertilizers and Stimulants. By N. N. Mokin. (*Chem. Abs.*, **26**, 1932, p. 2814. Abstr. from *Summ. of Curr. Lit.*, xii., **15**, 1932, p. 442.)

Pot experiments were carried out on a grey soil in cotton culture. Besides the fertilizers the following salts were added in amounts varying from 0·001 g. to 0·5 g. per pot of 12 kg. capacity: Potassium permanganate, manganese nitrate, boric acid, zinc nitrate, copper nitrate, sodium arsenite, lead nitrate, mercuric nitrate, sodium dichromate and sodium fluoride. All the salts exerted a definite influence on the development and fruit bearing of cotton. The most effective stimulants were manganese, copper, and fluorine compounds, which hastened the maturity and increased the yield of cotton.

67. Analytical Methods for Fertilizers. By A. Suchier. (*Die Analysenmethoden der Düngemittel, Berlin : Verlag Chemie*, 1931. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 7.) Under the head of "Phosphorus" this condensed compendium of analytical methods takes up first the analysis of the raw materials; second, that of artificially prepared phosphatic fertilizers. Under the caption "Nitrogen" are taken up (1) ammonium salts (including qualitative tests for the cyanide and thiocyanate radicles); (2) nitrates, natural and artificially prepared; (3) cyanamid; and (4) organic sources of fertilizer nitrogen. Under the head of "Potash," the naturally occurring and the prepared salts are similarly dealt with; and the two remaining main sections of the compilation present in a like manner the practical aspects of the analysis, respectively, of mixed fertilizers and of liming materials.

68. A Probable Cause of the Small Response to Fertilizers in the Cotton Regions of Armenia. By K. P. Mirimanian. (*J. Amer. Soc. Agron.*, xxiii., **9**, 1931. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 18.) Yields were found to be correlated with an increase in non-capillary porosity "as well as with an increase in replaceable calcium, which usually leads to an improvement in the physical properties of soils." The low response to fertilizers observed in the soils under investigation was therefore attributed, tentatively, rather to the unfavourable physical condition of the soil than to the fertilizer material itself.

69. Studies on Calcium Cyanamide. (*Jour. of Agr. Sci.*, xxii., **2**, 1932.) I.—The decomposition of calcium cyanamide in the soil and its effects on germination, nitrification, and soil reaction (E. M. Crowther and H. L. Richardson). II.—Microbiological aspects on nitrification in soils under varied environmental conditions (B. K. Mukerji). III.—Storage and mixing with superphosphate (H. L. Richardson).

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

70. Cotton Growing. By W. Peters. (*Queensland Agr. Jour.*, xxxviii., **1**, 1932, p. 71.) A radio talk to cotton growers in Queensland, dealing with the selection of suitable soils, the preparation of the land, ploughing, fallowing, and the rotation of crops.

71. Duration of Cotton Development Phases under Various Types of Weather. By E. E. Fedorov and A. D. Gedeonov. (In Russian, with a summary in English.) The authors state that the object of the paper is "to characterize different types of weather as to the rate of development of the cotton plant, and to supply numerical data for calculating phase duration." The method of using the data is explained.

72. The Interrelation of Factors Controlling the Production of Cotton under Irrigation in the Sudan. By F. G. Gregory, F. Crowther and A. R. Lambert. (*Jour. of Agr. Sci.*, xxii., **3**, 1932, p. 617.) The paper deals with the yields of seed cotton grown under irrigation in the Sudan in the seasons 1929-30, 1930-31. Interactions of four factors were studied in all possible com-

binations. The factors were: Four sowing dates, three spacings, three water duties, and nitrogen application. The layout of the experiment is described. The area occupied was approximately 10 acres, consisting of 288 plots, being the combinations of the four factors, each treatment replicated four times, $(4 \times 3 \times 3 \times 2) \times 4 = 288$. The plan of the experiment enabled the results to be tested statistically by analysis of variance. The effects of the single factors were found to be highly significant. The interactions of the factors in pairs were highly significant statistically with the exception of spacing *v.* water. All higher interactions were highly significant statistically except those involving combinations of spacing and water. The main results obtained were: (*a*) Yield both with and without nitrogen application has optimal value for August sowing. (*b*) The returns in yield for nitrogen application decline with advancing sowing date. (*c*) Spacing has little effect with early sowing irrespective of nitrogen application. (*d*) Spacing has large effect with late sowing irrespective of nitrogen application. (*e*) Water supply with early sowing and nitrogen application has large effect. (*f*) Water supply with early sowing without nitrogen has little effect. (*g*) Effect of water supply tends to disappear with advancing sowing date irrespective of nitrogen application. Various combinations of the factors may be utilized to give maximal yield, thus giving considerable latitude in sowing date without sacrifice of yield. These interaction effects are presented graphically, and their physiological interpretation is discussed. The results of the two years' experiments corroborate each other very closely, in spite of the fact that the yield in one year was only two-thirds that in the other. The agricultural bearing of the interactions is briefly discussed.

73. Sand Sowing in Growing Cotton. By G. Aboul Ela. (*Tech. and Sci. Serv. Bull. No.* 122, *Bot. Section Min. of Agr., Egypt.* 1932.) A discussion of some experiments carried out at the suggestion of Dr. Balls. Cone dibble sowing was found to be a great success, and with not more than five seeds in a hole, sand covering gave earlier and better results than covering with fine soil.

74. Cotton Ginning Investigations in U.S.A. By C. A. Bennett. (*Int. Cott. Bull.*, x., **40**, 1932, p. 506.) In 1930 funds were made available by Congress for a study of cotton ginning, and the investigations were commenced in January, 1931. The work involved mechanical tests, study of the influence of moisture on ginning, and analyses of the quality of the seed cotton and ginned cotton, being carried out on a large scale. A drying process, known as the "Government process," in which damp seed cotton is treated with a continuous current of hot air for 45 seconds to 3 minutes at a temperature usually of 160° to 200° F., has been developed and patented. A vertical design of cotton drier is also described. Working drawings of both machines can be obtained from the Bureau of Agricultural Engineering.

The next step was to determine the effects of cleaners, extractors, and cleaning-feeders, which handle the seed cotton prior to ginning. Apparently little is gained by an excessive handling of long-staple cotton, and hand picking still remains one of the most important factors in securing the highest grade in the sample. Providing clean, dry cotton to the gin is the most economical means of obtaining a high-quality sample.

The effects of "forcing" the gin are discussed, and tests point to a loose roll as the best way of obtaining a smooth sample. Speeding up a machine may result in deterioration of the output.

Other investigations are in progress, but are not yet ready for publication. Finally, it is pointed out that the personal element still comes in, and that good operators are absolutely necessary. The paper should be read by all who are concerned with cotton ginning.

75. Extraction of Dust from Cotton in Ginning Factories. (*Int. Cott. Bull.*, x., **40**, 1932, p. 551.) An investigation into the nature of dust in card rooms was carried out by the Shirley Institute on behalf of the Committee appointed by the British Government to enquire into the question. An analysis by weight of the dust attached to raw cotton showed that 90 per cent. was composed of organic matter, cotton hairs, leaf, fungi, and bacteria. The inorganic matter remaining was composed of 60 per cent. of silica and sand, and the balance of iron compounds.

[*Cf.* Abstr. **642**, Vol. IX., p. 345.]

76. Cotton Seed: Grading. By A. M. Hyde (Secretary, U.S. Dept. Agr.). (*Cott. Oil Press*, **16**, 1932, p. 45. Abstr. from *Summ. of Curr. Lit.*, xii., **18**, 1932, p. 503.) A reprint of the public notice establishing the grades, methods of sampling, analyzing and grading cotton seed sold or offered for sale for crushing purposes in the United States.

77. The Effect of Ingested Cottonseed Oil on the Composition of Body Fat. By N. R. Ellis *et al.* (*Jour. Biol. Chem.*, xcii., **2**, 1931, p. 385. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 61.) A test was conducted by the U.S.D.A. Bureau of Animal Industry in which pigs were fed cottonseed oil at 4, 8 and 12 per cent. levels. The hardest carcases on slaughtering were secured when 4 per cent. of cottonseed oil was fed, the higher quantities causing increasing softness.

DISEASES, PESTS, AND INJURIES, AND THEIR CONTROL.

78. Technique for Artificial Inoculations of the Cotton Plant. By W. S. Cook. (*J. of Econ. Ent.*, xxv., **4**, 1932, p. 766.) A description of the apparatus used in making artificial inoculations is given. A full description of the micro-manipulator and of the making of the capillary glass points is also included. The special technique used in making the inoculations is presented in detail.

79. Insect Pests: Influence of Temperature and Humidity on Control. By A. D. Imms. (*Ann. Appl. Biol.*, **19**, 1932, p. 125. Abstr. from *Summ. of Curr. Lit.*, xii., **14**, 1932, p. 414.) A review of recent experimental work on certain aspects of the influence of temperature and humidity on insect life, and the bearing of the results on problems of insect control.

80. Keys to the Pests of Cotton identified by the Damage caused and by their Injurious Stages. By P. V. Popov. (In Russian.) (Moscow, Nauchnoissledov. Inst. Khlopkovod., 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **10**, 1932, p. 567.) In this handbook keys are given to the Arthropods (almost all of which are insects) attacking cotton in the Russian Union, based on the type of damage caused and the morphological characters of the injurious stage, with brief notes on their distribution and economic importance. A list is given of 119 pests, showing their importance in the different cotton-growing areas. One chapter contains instructions for carrying out field observations at various periods of the year, and another deals with the collection, preparation, and transport of insects and plant specimens.

81. The Fauna of the Invertebrates feeding on the Cotton Plant. Areas of the Distribution of Different Species in the World. By V. V. Yakhontov. (In Russian.) (*Proc. Sci. Res. Inst. Cott. Cult. Ind. and Irrig.* NIHI. 39, Moscow, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **10**, 1932, p. 568.) The work contains a list of numerous invertebrates, most of which are insects, recorded in various parts of the world as injurious to cotton, including the stored material and seed, arranged alphabetically and with their synonyms. Notes are given on their distribution and economic importance, the character

of the injury, and the part of the plants attacked. A comprehensive bibliography is arranged in groups corresponding to the main continental regions where cotton is grown, and sketch-maps show approximately the areas of distribution of the more important pests. The importance of safeguarding cotton areas from the introduction of pests is stressed.

82. Eight Years of Experimental Work in Boll Weevil Control on Plots receiving Different Rates of Fertilizer. By J. M. Robinson and F. S. Arant. (*J. of Econ. Ent.*, xxv., **4**, 1932, p. 759.) Calcium arsenate controlled the boll weevil in one-twentieth-acre plots over an eight-year period. Infestation counts were made bi-weekly and calcium arsenate was applied when the infestation reached or exceeded 10 per cent. All applications were made during the day-time when the air was relatively calm.

83. Observations on a Combined Boll Weevil and Pink Bollworm Infestation in Northern Mexico. By C. S. Rude. (*J. of Econ. Ent.*, xxv., **4**, 1932, p. 772.) A combined heavy boll weevil and pink bollworm infestation occurred on cotton at Tlahualilo, Durango, Mexico, in 1931. Weekly records were made on the percentage of both square and boll infestation caused by the two species. It was found that the multiplication and development of neither species was checked by that of the other.

84. Migration and Population Studies of the Cotton Bollworm Moth (*Heliothis obsoleta*) in Texas. By J. C. Gaines. (*J. of Econ. Ent.*, xxv., **4**, 1932, p. 769.) A two-wheel cart type of screen trap, which was pushed along over cotton in the field, proved quite successful in obtaining information regarding the extent of local migration and the abundance of bollworm moths in the fields. Correlating these records with those taken in connection with oviposition, bollworm injury, and rate of plant growth, it was found that oviposition and the rate of plant growth were closely associated, but that there was no relation between the moth population and the oviposition in these fields.

85. Host Plant Studies of the Pink Bollworm. By C. S. Rude. (*J. of Econ. Ent.*, xxv., **4**, 1932, p. 751.) At Tlahualilo, Mexico, in the State of Durango, the following species of native, wild, malvaceous plants were found to be host plants of the pink bollworm of cotton, namely: *Hibiscus cardiophyllus*, Gray, *Hibiscus coulteri*, Gray, and *Hibiscus denudatus*, Gray. Two species of cultivated malvaceous plants were also recorded as host plants, namely: okra (*Hibiscus esculentus* L.), and hollyhock (*Althæa rosea* L.). The comparative importance of these plants in maintaining pink bollworm infestation in the absence of cotton is discussed, together with notes on distribution and habitat.

86. Detecting Pink Bollworms in Cotton Seeds by the X-Ray. By F. A. Fenton. (*J. Agr. Res.*, xlv., **6**, 1932, p. 347.) It was found that the presence of live or dead larvæ in the seeds could be easily detected by means of X-rays, but the method would be too expensive for regular use in the examination of limited numbers of seeds.

87. Biology of the Pink Bollworm at Presidio, Texas. By W. L. Owen, jun., and S. L. Calhoun. (*J. of Econ. Ent.*, xxv., **4**, 1932, p. 746.) *Summary.* The period and rate of emergence of long-cycle moths was governed largely by temperature and rainfall. The peak of emergence also occurred at markedly different dates as follows: April 25, 1928, May 11, 1929, and June 13, 1930. Available moisture and the addition of fresh cotton "slips" to cages increased the longevity of long-cycle moths considerably. Short-cycle moths lived for a longer period than long-cycle moths. The majority of females began oviposition on the third day after emergence, and the largest average number of eggs laid during any 12-hour

period were deposited on the first night of oviposition. Short-cycle moths possessed greater vigour and higher reproductive powers than long-cycle moths. Most of the eggs hatched 4·5 days after deposition at a mean temperature of 83·04° F. The feeding and pupal periods were of shorter duration for larvæ which fed in squares than for those which fed in bolls. This affected the duration of the total life-cycle, which averaged 26·60 days for the former as compared with 32·93 days for the latter. In 1931 six complete generations were developed in squares, but only three and a partial fourth in bolls. Long-cycle larvæ appeared first in open bolls, then in green bolls, and finally in squares.

88. The Infestation of Young Okra Pods by Pink Bollworm in Porto Rico. By G. N. Wolcott. (*J. Dpt. Agr. Puerto Rico*, xv., **4**, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **9**, 1932, p. 512.) Investigations showed that though under ordinary conditions infestation of okra pods does not occur, even the youngest pods may become infested when adjacent cotton is heavily attacked.

89. Work on the Pink Bollworm, Virgin Islands. By U. C. Loftin. (*Virgin Is. Sta. Rpt.*, 1931. Abstr. from *Exp. Sta. Rec.*, 67, **5**, 1932, p. 573.) Pink bollworm was found to be widely scattered over the wild cotton area. It was also found on okra, and to a less degree on otaheite (*Thespesia populnea*) and *Hibiscus vitifolius*. To eradicate the pest it was decided to clean up the wild cotton, which is the most important host plant, and adopt a 2-year or 3-year close season before planting cotton again.

90. Beiträge zur Kenntnis der Zweifelhaften Parasiten der Acrididen. By B. B. Rohdendorf. (In Russian, with a summary in German.) (*Bull. Plant Prot., I., Ent. No.* 3, Leningrad, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **9**, 1932, p. 504.) Diptera observed parasitizing *Schistocerca gregaria*, Forsk. in Russian Central Asia were *Stomatorrhina lunata*, F., and *Oophagomyia plotnikovi*, Rohd., found in the egg-pods, and *Blæsoxipha laticornis*, Mg. (*grylloctona*, Lw.), *B. filipjevi tertia*, Rohd., and *B. monticola*, Rohd., in the hoppers and adults. Four other species of flies bred from this locust were probably not parasites of living individuals, as they are normally saprophagous. *Blæsoxipha rossica*, Villen., and *B. subamericana*, sp.n., were bred from *Gomphocerus sibiricus*, L. An illustrated key is given to the Palæarctic species of *Blæsoxipha* and *Locustævora* parasitic in Acrididae.

91. Observations Experimentales sur le Criquet Pèlerin (*Schistocerca gregaria*, Forsk.). By P. Vayssière. (*C. R. Acad. Sci. Fr.*, cxcv., No. 2, Paris, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **9**, 1932, p. 504.) Experiments proved that sexual maturity can be attained without a migratory flight under the influence of high temperature and humidity. In experiments with hoppers hatched from eggs laid by typically gregarious locusts, those that were isolated suffered a high degree of mortality and developed less rapidly than those that were kept crowded.

92. The Migratory Locust. By W. V. Harris. (*Pamphlet No.* 6, *Dpt. Agr. Tanganyika*, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **8**, 1932, p. 449.) An account of observations in Tanganyika on the bionomics and control of *Locusta migratoria migratorioides*, Rch. and Frm., all stages and phases of which are described. The present outbreak of this locust, which began in February, 1931, was preceded by the appearance of small swarms of *Schistocerca gregaria*, Forsk., during March to May, 1928, and in November, 1929, and of small swarms of *Nomadacris septemfasciata*, Serv., in May, 1930. A similar cycle of events occurred between the years 1890 and 1901, except that *N. septemfasciata* was the last of the three locusts to appear. During the intervening years *S. gregaria*

was the only species to recur, namely in 1903-4 and 1914-15. Keys are given for distinguishing these species and *Anacridium moestum*, Serv.

The origin of the 1931 infestation by *L. migratoria migratorioides* is discussed, the main line of flight into Tanganyika being from north to south along the eastern and western borders of Lake Victoria, and changing to a westerly direction between 2° 50′ and 4° 50′ S. Lat.

Natural enemies include the Carabids, *Anthia artemis*, Gerst., *A. æquilatera*, Klug, and *A. maculicollis*, Perr (*striatopunctata*, Guer.), which have been observed attacking fifth instar hoppers, and larvæ closely resembling those of *Stomatorrhina lunata*, F., attacking the egg pods. Nematode worms of the genus *Mermis*, and red mites were found infesting hoppers and adults. Large numbers of tracheal mites resembling *Acarapis* were discovered in the thoracic sacs and the trachese. Attempts to infect caged locusts with the fungus *Empusa* were unsuccessful. Control measures include dusting or spraying with sodium arsenite, and the use of poison baits.

93. Further Studies of the Biology of the Migratory Locust (*Pachytylus migratorioides*, R. and F.), *Locustidæ orthoptera*. By S. S. Gonzales. (*Philipp. J. Agr.*, iii., **1**, Manila, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **9**, 1932, p. 498.) Deals with the locust question in the Philippines, and emphasizes the necessity for closer co-operation in control work.

94. Locusts in the Sudan, 1932. By H. H. King. (Abstr. from the *Rpt. of Govt. Ent.*, 1931. *Bull. No.* 35, *Wellcome Trop. Res. Labs.*, 1932.) Deals with the incidence in the Sudan in 1931 of the desert locust, *Schistocerca gregaria*, and the hairy-chested locust, *Locusta migratorioides*. A good measure of control was obtained by means of poison bran bait, and further control was suggested by dusting flying swarms from aeroplanes with sodium arsenite.

95. Nouvelles Observations sur les Sauterelles du Sahara, du Niger et du Soudan français. By A. Chevalier. (*Rev. Bot. Appl. Agr. Trop.*, xii., Nos. 131-132. Paris, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **10**, 1932, p. 559.) An account of observations on locusts, made during a journey across the Sahara to the Niger and the French Sudan from December to April, 1931, with notes on the seasonal migrations of each species, of which *Locusta migratoria migratorioides* and *Schistocerca gregaria* are the most important.

96. On the Organization of the Control of the Adult Moroccan Locust with Poisoned Bran Mash. By V. Raevskii. (In Russian.) (*Bull. Plant Prot. I. Ent., No.* 3, Leningrad, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **9**, 1932, p. 501.) Flying swarms of *Dociostaurus maroccanus*, Thnb., present a serious danger to crops, particularly cotton, in Central Asia. Observations on the behaviour of the swarms showed that the locusts feed before and during the oviposition period, and in field experiments they were readily killed by poison baits of the usual composition. The bait must be scattered very early in the morning, as the locusts are easily disturbed later on and even until late in the evening. Crops can be protected from swarms if the bait is scattered while they are settling. Some observations suggest that bait is taken by the adult locusts even if it is dry.

97. Locust Control. (*Econ. Advisory Council, Fourth Rpt. of Comm. of Locust Control*, London. H.M. Stat. Off., Cmd. 4124, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **9**, 1932, p. 499.) A review of the locust situation in Africa and Western Asia during the period from May, 1930, to January, 1932, shows that invasions of this pest exhibit little signs of abatement. The further outlook is regarded as unsatisfactory, and the importance of discovering the original breeding grounds is stressed.

A report is presented of the locust investigations conducted by the Imperial Institute of Entomology, both in London, where the information is collected and studied, and in the field. A field laboratory is being established in the Sudan for studying the conditions of breeding of *Schistocerca* on the spot, and a similar laboratory is suggested in East Africa for investigating *Locusta*. The estimated cost of the investigations is £3,800.

An appendix contains an estimate of losses caused by locusts in different countries during 1927-31. The total expenditure on control measures during this period was not less than £1,000,000, while the total number of man-days occupied in controlling the pest is estimated at 28,000,000. The losses caused to crops are very imperfectly recorded, but known figures amount to about £6,000,000.

98. THRIPS AFFECTING THE COTTON CROP IN THE GEZIRA IN 1930. By W. L. P. Cameron. (*Rpt. of Govt. Ent.*, 1930. *Bull. No.* 34, *Wellcome Trop. Res. Labs.*, 1931.) Brief descriptions are given of two species of *Heliothrips* which attack the leaves of cotton plants, and of certain species of thrips of another genus, so far undetermined, which attack the buds of the plant. Notes are included on the habits of the pest, and on the results of experiments and control measures.

99. INSTANT BORDEAUX. By F. J. Schneiderhan. (*West Virginia Sta. Circ.* 60, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **2**, 1932, p. 138.) The author describes a simple, rapid, and exact method of preparing Bordeaux mixture. The designation Instant Bordeaux mixture is given to distinguish the fungicide prepared by this method from that prepared from stock solutions. Seven years of study and experimentation were given to the development of this method, which, it is said, has been adopted by many growers in the Shenandoah Valley.

The mixture is made by using powdered copper sulphate, known commercially as "snow," in place of crystallized copper sulphate, and high calcium hydrate instead of quicklime, as recommended in the standard preparation. Directions are given for the preparation of a 2-4-50 formula for use in a 300-gallon spray tank, and it is stated that the time required to mix a tank full by this method is only slightly longer than that required to fill the tank with water. In preparing this mixture, it is desirable to use chemical hydrated lime, as ordinary agricultural hydrated lime is unsuited because of its comparative coarseness and the presence of considerable gritty material. Very successful results were obtained in experiments with this mixture, carried out over three years, to control apple blotch.

100. FUNGICIDES: LABORATORY EXAMINATION. By H. Martin. (*Ann. Appl. Biol.*, **19**, 1932, p. 263. Abstr. from *Summ. of Curr. Lit.*, xii., **14**, 1932, p. 413.) A general account is given of the methods used in the laboratory examination of fungicidal dusts and sprays. Two types of fungicides, direct and protective, are differentiated, and the factors affecting their efficiency are indicated. The formation of the toxic agent from the protective deposit of fungicide is usually ascribed to one or a combination of three reactions brought about, firstly, by atmospheric agencies such as carbon dioxide; secondly, by the intervention of the fungus spore; thirdly, by secretions or other reactions on the part of the host plant. Methods of investigating these reactions are described and examples are discussed.

101. EFFECT OF ENVIRONMENTAL FACTORS UPON THE AMOUNT OF INJURY TO COTTON SEEDLINGS BY THE NEMA *Aphelenchus parietinus*. By C. H. Arndt. (*S. Car. Sta. Rpt.*, 1931, p. 51.) In a discussion of the effect of environmental factors upon the amount of injury to cotton seedlings by the nema *Aphelenchus parietinus*, it has been noted that unfavourable conditions for the growth of the plant greatly increased the damage by this organism. Further evidence that this may be true was secured in greenhouse studies on soil from the Pee Dee Station which had

apparently been poisoned by applications of calcium arsenate, and a similar soil which had not received any arsenical. In the cool section of the greenhouse where the temperature range was 18° to 20° C., the average seed germination was 50 per cent. greater in the soil which had not received any arsenic than in the one to which arsenic had been applied. The plants in both soils were severely injured by this nema. In both soils the seed germination and nema injury was less at a soil moisture content of 50 per cent. of the water-holding capacity than in the soil at higher moisture content. In the warmer section of the greenhouse (temperature 25° to 30° C.), the germination in both soils was similar, as also was the number of seedlings attacked by nemas. The seedlings in the soil which had not received any arsenic, however, soon outgrew the injury, and at the end of two months showed little evidence of it. The plants in the treated soil were much smaller, and still showed severe nema injury at the end of two months. In the arsenic-containing soil the plants made very good growth when the soil was heated with steam or treated with toluol. Most of the plants in both soils had galls of the root nema on their roots.

102. Strangulation of Cotton Roots. By J. J. Taubenhaus *et al.* (*Plant Physiol.*, 6, **1**, 1931. Abstr. from *Exp. Sta. Rec.*, 67, **5**, 1932, p. 546.) The authors report having received from Texas, Arkansas, and Mississippi specimens of a peculiar cotton root trouble. The affected plants usually possessed well-developed root systems, but the upper parts of the tap and lateral roots were separated from the lower parts by constrictions often an inch or more in length and 0·3 to 0·4 mm. in thickness. No evidence of decay was present, and studies indicated that the malformation was of a non-parasitic nature. It is said to occur only in flat, poorly-drained, heavy clay soils, which are compacted by continuous rain or irrigation, and then further hardened in the absence of cultivation, by continued hot, dry weather. The affected plants were found to die when the constricted areas were killed, or when the moisture supply transported through the constricted areas became inadequate for the requirement of the plants.

103. Treatment of Cotton Root Rot Nematode Disease. (Trans. title.) By A. V. (*Agron. Colon.*, 19, No. 146, 1930. Abstr. from *Exp. Sta. Rec.*, 67, **4**, 1923, p. 406). In the vicinity of cotton plants, nematodes (*Heterodera radicicola*) attacking cotton roots find harbourage in such plants as *Ageratum* sp. and *Amaranthus* sp. favoured by air and light. These nematodes may be controlled by the use of such shading plants as peas, or by use of such disinfectants as carbon disulphide or formol. The successive distribution of sodium cyanide at 600 kg. and of ammonium sulphate at 900 kg. per hectare in the soil destroys the nematodes and a wide range of injurious insects as well. The cost is said to be about 1,500 francs per hectare, but the effect lasts during four to five years. A disadvantage of the treatment is that it causes high soil acidity, and hence lowers its fertility. This may be remedied without injury, if care be exercised, by the addition of lime or of wood ash.

104. Enfermedades de las Plantas Cultivadas en el Peru. By E. V. Abbott. (*Circ. No.* 18, *Estacion Experimental Agricola de la Molina*, Peru, 1931.) A description of various diseases of cultivated plants in Peru. Cotton diseases caused by the following are included: *Fusarium vasinfectum, Corticium vagum, Heterodera radicicola, Alternaria tenuis, Helminthosporium gossypii.*

105. An Atypical Lesion on Cotton Leaves caused by *Bacterium malvacearum*. By M. K. Bryan. (*Phytopath.*, xxii., **3**, 1932. Abstr. from *Rev. App. Mycol.*, xi., **6**, 1932, p. 511.) Cotton leaves collected in North Carolina in 1929 showed large, irregular, pale green or grey, necrotic areas apparently resulting from internal vascular disorganization. Sections through the lesions showed extensive

infection of the vascular system, from which was isolated a strain of *Bacterium malvacearum* differing only in a few minor respects from the type species. Inoculations with subcultures from these isolations gave typical angular spot lesions on the leaf blades, petioles, veins, and bolls, as well as the above-mentioned large, pale spots. Parallel inoculations with a freshly isolated strain of *Bact. malvacearum* from typical angular spot gave the ordinary lesions characteristic of this disease but no systemic infection, of which there is, moreover, apparently no previous record. Serious defoliation was reported to result from infection by the new strain of *Bact. malvacearum.*

106. Agglutination Studies on *Phytomonas malvaceara.* By O. B. Williams and H. B. Glass. (*Phytopath.*, xxi., **12**, 1931, p. 1181. Abstr. from *Rev. App. Mycol.*, xi., **5**, 1932, p. 297.) The results, which are discussed and tabulated, of agglutination experiments with 14 strains of *Phytomonas malvaceara* (*Bacterium malvacearum*) isolated from field cotton in Texas, showed that a high-titred agglutinating serum can be produced for this organism. Cross reactions with heterologous strains of the same organism revealed considerable differences in agglutinating titre, but no fundamental serological variations between the strains used could be established by absorption tests.

107. Leaf-Curl of Cotton in Garden Zinnias in North India. By R. N. Mathur. (*Nature*, cxxix., **3265**, 1932, p. 797. Abstr. from *Rev. App. Mycol.*, xi., **9**, 1932, p. 573.) Recent investigations on a virus disease of garden zinnias at Dehra Dun suggest that it is identical with leaf-curl of cotton in the Sudan, and transmitted by the same vector (*Bemisia gossypiperda*). Pending detailed results of the studies now in progress, it was thought that the presence of this disease and its insect carrier in India should be brought to the notice of those interested in the cotton industry of the country.

108. Areolate Mildew of Cotton. By J. Ehrlich and F. A. Wolf. (*Phytopath.*, xxii., **3**, 1932, p. 229. Abstr. from *Rev. App. Mycol.*, xi., **8**, 1932, p. 512.) Latin and English diagnoses are given of *Mycosphærella areola* n. sp., the ascigerous stage of *Ramularia areola* (*Cercosporella gossypii*), which is a common cause of mildew on cotton (*Gossypium hirsutum*, *G. barbadense*, *G. peruvianum*, and *G. vitifolium*) in the south-eastern United States and many other parts of the world.

In addition to the conidial stage, borne on the lower and occasionally also the upper surfaces of the pale to yellowish-green lesions on the leaves and bracts, the authors found spermogonia appearing as black spots on the lesions in November and December. In the early stages they are sclerotium-like bodies, 28 to 75 μ in diameter, composed of compact, thick-walled cells, of which the innermost are the first to become spermatiferous. Each protoplast undergoes separation into a number of rod- or bone-shaped spermatia, after which the cell wall disintegrates and the spermatia are liberated in a matrix consisting of cytoplasm and disintegrating cell walls. The process continues centrifugally until only the outer layers of thick-walled cells remain. With the apical opening of the spermogonium the spermatia, which measure 2·4 to 4 by 0·4 to 2 μ, are exuded in a viscous mass through the ostiolum. The perithecia, which develop sparsely in April on the areas previously occupied by the conidia and spermogonia, are dark brown, with a slight papilla, and measure 70 to 80 μ in diameter. The asci measure 35 to 40 by 6 to 8 μ, and the biseriate, elongated ascospores, slightly constricted at the septum, 12·4 to 15·6 by 3·2 to 3·8 μ.

Considerable difficulty was experienced in obtaining pure cultures of the cotton mildew organism, but a small proportion of the conidia germinated in tap or distilled water to which fragments of cotton leaves or traces of sugar were added. Isolations from ascospores were made by inverting agar plates over

decaying leaf fragments on moist blotting-paper in the tops of Petri dishes; on transference to potato-agar slants colonies of the conidial type developed, but neither conidia nor spermogonia were formed. Inoculation experiments gave consistently negative results, no doubt primarily due to the absence of suitable moisture conditions, as indicated by the observation that wet seasons are necessary for field infection.

109. The Influence of Date of planting Cotton on the Development of Root Rot. By B. F. Dana *et al.* (*J. Amer. Soc. Agr.*, xxiv., **5**, 1932, p. 367. Abstr. from *Rev. App. Mycol.*, xi., **10**, 1932, p. 639.) An extensive range of cotton plantings was made at Temple, Texas, from 1928 to 1930 inclusive, to determine the influence of the date of planting on the incidence of root rot (*Phymatotrichum omnivorum*) in Houston black and clay soils, which are very favourable to the disease. In 1928 the plantings were made on April 1 and 15, May 1 and 15, and June 1 and 15; in 1929, on April 22 and May 4 and 20; and in 1930, on April 10 and May 1 and 29. Several out-of-season plantings were also made—viz., on March 15 and June 1 and 15 in 1928 and on June 13 in 1929. The Delfos, Kasch, and Bennett varieties (early, medium, and late, respectively) were used for each date in each year. In 1928 and 1929 Westex (early), Acala (medium), Sunshine (medium), and Mebane (late) were also used.

The first appearance of the disease was found to be influenced by the age of the crop. In no instance did less than thirty days elapse between the planting and the first sign of infection. For the planting of June 15, 1928, the initial infections were later on the average than in that of June 1, while at the latter date the appearance of the disease was delayed as compared with May 15. In 1929 infection occurred later on the planting of May 20 than on that of May 4, and still later on that made on June 13. Again, the plantings made on May 1 and 20, 1930, showed a greater delay in the appearance of the disease than those of April 10. The absence of any relation between the age of the plants and the amount of root rot infection in the earlier sowings suggests that some other factor, probably temperature, is of primary importance at this time. After root rot was established, however, and temperatures had become favourable to infection, the age of the plant exerted a decisive influence. In Delfos, for instance, the infection counts on August 11, 1928, showed losses of 16·1, 23·5, 17·6, 11·0, 8·0, 3·6, and 1·4 per cent., respectively, in early to late plantings from March 15 to June 15. In 1929 (counted on August 12) the percentages were 21·3, 17·0, 7·1, and 6·4 from April 22 to June 13, and again in 1930 (August 11) the plantings made from April 10 to May 20 showed a rapid decline in loss percentages in the order of 23·8, 13·6, and 7·0 respectively.

110. Growth of *Phymatotrichum omnivorum* in Plant Juices as correlated with Resistance of Plants to Root Rot. By W. N. Ezekiel *et al.* (*Phytopath.*, xxii., **5**, 1932, p. 459. Abstr. from *Rev. App. Mycol.*, xi., **10**, 1932, p. 640.) *Phymatotrichum omnivorum*, the causal organism of cotton root rot, was grown in the juices expressed from four monocotyledonous plants—viz., maize, onion, *Canna*, and nut grass (*Cyperus rotundus*) resistant to the disease, and from four dicotyledonous plants (cotton, carrot, turnip, and sweet potato) susceptible to it. The oven-dry weight of the resulting mycelium was determined. The growth of the fungus was markedly inhibited in the undiluted but autoclaved juices of all the resistant plants, whereas profuse development occurred in the juices of all the susceptible ones except turnip.

111. Resistance of Monocotyledons to *Phymatotrichum* Root Rot. By J. J. Taubenhaus and W. N. Ezekiel. (*Phytopath.*, xxii., **5**, p. 443, 1932. Abstr. from *Rev. App. Mycol.*, xi., **10**, 1932, p. 639.) Laboratory and field inoculation

experiments (details of which are given) in Texas on a large number of monocotyledonous plants with the causal organism of cotton root rot (*Phymatotrichum omnivorum*) gave entirely negative results, whereas control inoculations on cotton, carrot, and okra (*Hibiscus esculentus*) caused the development of typical symptoms in every case. Evidently, therefore, the monocotyledons tested are neither hosts nor carriers of the fungus.

112. Resistance of the Turk's Cap Hibiscus, *Malvaviscus conzattii*, to Phymatotrichum Root Rot. By W. T. Bach and J. J. Taubenhaus. (*Phytopath.*, xxii., **5**, 1932, p. 453. Abstr. from *Rev. App. Mycol.*, xi., **10**, 1932, p. 640.) The Turk's-cap *Hibiscus* (*Malvaviscus conzattii*) appears to constitute an exception to the rule that plants belonging to the Malvaceæ are highly susceptible to cotton root rot (*Phymatotrichum omnivorum*). Among eighty-two species of this family, *M. conzattii* was the only one showing no infection under field conditions in Texas, while 1,066 inoculation tests on well-established plants also gave negative results.

113. Treatment of Cotton Root-Rot with Ammonia. By D. C. Neal *et al* (*Science*, **75**, *No.* 1935, 1932, p. 139. Abstr. from *Exp. Sta. Rec.*, lxvii., **2**, 1932, p. 141.) Cultural experiments are said to have shown that the mycelial and conidial stages of *Phymatotrichum omnivorum* were killed by short exposures to ammonia gas, and that where dilute concentrations of the hydroxide were applied under field conditions the fungus was killed in the tissues of cotton roots. Field tests were made to compare the effectiveness of ammonium hydroxide, formalin, and sodium hypochlorite when applied to cotton roots. Disinfection with ammonia appeared to be more complete than with other chemicals used, and the danger of killing adjacent plants, as by the application of formalin, was avoided. The possibility of utilizing ammonia or ammonium compounds for the control of the disease in cotton fields is suggested.

114. Cotton Disease Investigations at the Sacaton, Arizona, Field Station. By C. J. King and H. F. Loomis. (*U.S. Dpt. Agr. Circ.* 206, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 44.) The results are given of studies in connection with the following: the use of barnyard manure, of clean fallow, and of various mechanical barriers in reducing injury from cotton root-rot (*Phymatotrichum omnivorum*); the viability of root-rot sclerotia; the effect of crazy top (acromania); boll shedding of unshaded and shaded cotton plants; the occurrence and control of root knot (*Caconema radicicola*) in cotton; and the occurrence and control of the sore shin disease (*Corticium vagum*).

115. A Study of the Pathological Anatomy of the Cotton Plant in Connection with the Wilt Disease (*Fusarium vasinfectum*). By K. Dharmarajulu. (*Ind. J. of Agr. Sci.*, ii., **3**, 1932, p. 293.) The work recorded in this paper was undertaken with a view to finding out: (1) The mode of penetration and the further progress of *Fusarium vasinfectum* under ordinary atmospheric conditions, in three varieties of cotton plants (susceptible, resistant, and immune) that vary in the degree of their resistance. (2) Whether there are any histological differences that distinguish the three varieties. (3) How the three different hosts react towards the infecting hyphæ under controlled conditions of temperature.

The cottons chosen for the study were Dharwar I (susceptible), Dharwar II (resistant), and Gadag I (immune).

Summary.—The mode of entry of the parasite and the manner of its progress are the same in all the varieties of cotton—susceptible, resistant, immune—irrespective of their capacity to resist. Single hypha was seen to make its way successfully through the peripheral cork and suberized cell walls in Dharwar II and Gadag I, without a weft being formed. In Dharwar I, the susceptible type,

the fungus made its way into the epidermis on the fourth day and reached the xylem on the eighth day after inoculation. In the resistant Dharwar II and immune Gadag I, though the entry was on the fourth day as in Dharwar I, it could just enter the endodermis or reach its outer walls on the eighth day. At the ordinary temperatures of the plant house the resistant and the immune types were seen to develop peripheral cork first over the infected portion and later over the other parts of the root, as the fungus encircled it. At low temperatures like 25° C. or below, the susceptibility of Dharwar I and Dharwar II greatly increased. Even the immune type had shown susceptibility to a slight extent. The infected plants of these types at low temperatures showed the suberization of the epidermal and cortical cell walls (one or two layers). A little peripheral cork was also developed more prominently under the points of infection. The initiation of secondary thickening of the root in the infected plants was much earlier in the controls. The controls showed only the suberization of their epidermal walls. At higher temperatures like 32 to 34° C. the susceptible type resisted to a greater extent and Dharwar II and Gadag I showed no deaths. The peripheral cork was thick in the infected roots of all varieties at high temperatures. The epidermal cells all round and cortical cells directly below the point of attack, as well as those in their neighbourhood, were not only stimulated to develop suberin in their walls in advance of the approach of the fungus, but their cell contents were also disorganized to a greater or less extent in all the varieties. The controls of these showed nothing but slight suberization of the epidermal cells. The development of peripheral cork and the suberization of the cells do not constitute the main cause of resistance, though they could not be dispensed with. Resistance in cotton seems to be due in the main to the nature of the host protoplasm.

116. VERTICILLIUM WILT (*Hadromycosis*) OF COTTON IN THE SAN JOAQUIN VALLEY OF CALIFORNIA. By F. W. Herbert and J. W. Hubbard. (*U.S. Dpt. of Agr. Circ.*, 211, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 44.) A wilt disease of cotton, caused by the soil fungus *Verticillium alboatrum* and first observed in 1927, is described with relation to symptoms, effects on various types of cotton, and its difference from *Fusarium* wilt. Possible sources of infection and the possibility of control are briefly outlined.

GENERAL BOTANY, BREEDING, ETC.

117. RECENT ADVANCES IN CYTOLOGY. By C. D. Darlington. (J. and A. Churchill, London, 1932. Price 18s. From *Plant Breeding Abstracts*, iii., **1**, 1932, p. 39.) Karyology, the new science of the nucleus, with which this volume is concerned, has advanced with such rapidity that all but the specialists have been virtually left behind for some time past, all the more so as no comprehensive treatise on the subject has appeared for some time.

The latter difficulty now no longer exists. The first part of the work under review is designed "for the student who is a beginner," the second part for the research worker, and the third part is a presentation of the author's own hypothesis and views concerning the theoretical aspect of the subject, an aspect which has only recently, and largely in the hands of the author and a few others, been developed.

The subject is a difficult one, and those not versed in it will not find the volume easily assimilable. It is, however, of such vital importance in relation to heredity that no serious student of genetics or breeding can afford to neglect it. The ordinary facts of nuclear division are described in the light of modern knowledge. Examples of interest to the geneticist are too numerous to quote; among them are the principle of the constancy of the unit-particles making up the chromo-

some, the chromomeres or genes; the connection between racial, and often specific, differences and differences in chromosome morphology, number, etc., the random pairing of chromatids in auto-polyploids; the chromomere rather than the chromosome as the unit of pairing.

The chromosome behaviour in hybrids differing and not differing in chromosome structure is analyzed in some detail. It is shown that the influence on pairing of dissimilarities in the chromosomes is influenced by the degree of chiasma formation in the chromosomes concerned, and this in turn by the length of the chromosomes. Thus, it is pointed out that chromosome pairing is not always a reliable criterion of relationship.

The question of polyploids of various types is treated in considerable detail, a whole chapter being devoted to their behaviour, from which much insight is gained into the nature of chromosome pairing and the factors upon which it depends. From this point of view studies of the various cases of autosyndesis are particularly instructive, and when applied to polyploid species give indications of their degree of differentiation.

The evolution of polyploids receives a chapter to itself, in which arguments are adduced to show the importance and nature of the role of polyploidy in the origin of the species. Considerable significance is attached to the difference between meiotic pairing (chiasma formation) and somatic pairing, as shown by many secondary polyploids with secondary pairing.

To "the chromosomes in heredity" two chapters are devoted, in which the quantitative relations of the chromosomes are discussed, the evidence for the cytological basis of crossing-over reviewed and a body of evidence adduced in support of the chiasmatype theory of crossing-over between two of the four chromatids before the formation of chiasmata. This leads to a presentation of the author's view of meiosis, in which its close correspondence with mitosis is argued, the one essential difference being shown to be the relatively later division of the chromosomes into chromatids. Various abnormalities of meiosis and ways in which this may be conditioned are described; many of these can be explained on the view of meiosis previously presented; experimental geneticists and many plant breeders will find this section particularly instructive, and leading from this the cognate section on apomixis, in which the ways and conditions under which meiosis or fertilization or both may be omitted from the reproductive cycle are discussed in some detail.

The last chapter is devoted to views and suggestions, certain of them highly speculative and original, on fundamental questions such as the origin and essential nature of the gene, the phenomena of nuclear behaviour, the sexual cycle, apomixis, segregation in parthogenetic species, polyploidy, and secondary polyploidy, the species and evolution. Selection on the products of variation resulting from discontinuous gene, structural or numerical change, is regarded as the mechanism of evolution.

The volume gains enormously in value in being furnished with a glossary of current cytological terms, and a bibliography of selected works and works referred to in the text.

118. The Mechanism of Creative Evolution. By C. C. Hurst. (Cambs. Univ. Press., 1932. Price 21s. net.) A very interesting account of the great progress that has been made in the science of genetics in the last ten years. Such subjects are dealt with as Mapping the Genes in the Chromosomes; Chromosomes and Species; Translocations of Genes; Polyploid Species; Hybridization (mainly as a source, under certain conditions, of new species); Gene Mutations; Sex; The Gene as a Unit of Life; Processes of Creative Evolution. The four great advances are defined: (1) The discovery of the transmutations of chromosomes and genes

leading to the experimental creation of new varieties and species; (2) the experimental creation of gene mutations and chromosome transmutations by the application of X-rays and other short-wave radiations; (3) the discovery that specific and higher group characters are also represented by genes which, after mutation, behave as Mendelian varietal characters; (4) the translation of the Linnean concept of species into terms of genes and chromosomes, thus establishing, in the genetical species, a measurable unit of evolution together with a new exact science of taxonomy founded on an experimental basis. The work is very clearly written, and should be read by all who are anxious to keep up with modern science. It is well furnished with excellent illustrations. The general thesis is that quoted on the wrapper, that "a critical period in human history has arrived. Man, if he chooses, can, here and now, take a hand in creative evolution by creating new species of living organisms and replacing natural selection by human selection." Natural selection is put in its proper place as the arbiter, but not the cause, of creative evolution, and it is clearly shown that in future evolutionary theories will have to be stated in terms of genes and chromosomes.

119. THE GENETICS OF GOSSYPIUM. By S. C. Harland. (Reprint from *Bibliographia Genetica*, ix., 1932.) This is a paper which no worker upon cotton, and especially its breeding, can afford to be without, since it gives not only a description of accepted species, but a detailed review of the literature (with bibliography). The various sections are headed: Taxonomy; Classification; Key to Species; Cytology; Genetics of Cotton:—(A) *Plant characters:* Habit, Chlorophyll deficiency, Anthocyanin colour of the plant body, Branching habit, Crinkled dwarf, Hairiness, Male sterility; (B) *Leaf characters:* Colour of cotyledonary stalk, Leaf shape, Leaf colour, Leaf spot, Leaf nectaries; (C) *Flower characters:* Number of bract teeth, Laciniation of the bract, Hairiness of the calyx, Corolla-type of opening, Petal length and shape, Corolla colour, Petal spot, Anthers-time of bursting, Filament length, Pollen colour, Pollen grain size, Column length; (D) *Boll characters:* Shape and size, Boll loculi, Midlock furrow, Pittedness, Surface, Type of opening; (E) *Lint characters:* Lint colour, Lint length, Lint index, Ginning percentage, Fineness, Looseness; (F) *Seed characters:* Fuzz, Fuzz colour, Kidney seed, Weight; (G) *Physiological characters:* Resistance to Cotton leaf blister-mite, to Aphis, to Jassids, to Black scale, to Angular spot, to Wilt, to Leaf cut, to Crazy top, and to Stenosis; shedding. Correlations; List of genes; Linkage relations. The book is also furnished with an index.

120. KONSEQUENZEN DER VERERBUNGSLEHRE FUR DIE PFLANZENZÜCHTUNG. (The consequences of genetics for plant breeding.) By E. Baur. (*Handb. Vererbungswissensch.*, iii., 1932. From *Plant Breeding Abstracts*, iii., **1**, 1932, p. 39.) This article deals briefly with the application of genetics to the practice of plant breeding. The various methods of selection are described and the theory underlying their use is indicated. Crossing, both of varieties and species, is similarly treated. The value of mutation and polyploidy is discussed as well as the occurrence of periclinal chimæras, the gradual effects of conditions of cultivation and the creation of new forms. The part played by genetics in breeding for immunity is indicated. The organization of the breeding work in the different countries is noted, and a plea is made for some form of protection for the plant breeder, such as the introduction of plant patents.

121. NEW METHODS OF COTTON CULTIVATION: HYBRIDIZATION, VEGETATIVE PROPAGATION, NEW METHODS OF TRANSPLANTING. By K. A. Vysotskii. (NIHI. Moscow and Tashkent, 1932. From *Plant Breeding Abstracts*, iii., **1**, 1932, p. 28.) The question of high yield, especially of high-quality Egyptian varieties, is of primary importance. In this connection one of the most important measures

is the cultivation of perennial types of Egyptian cotton and of first generation interspecific hybrids between American and Egyptian types, which have proved to be of very high quality. The object in making these crosses was to unite in one strain the valuable lint qualities of the Egyptian (Sea Island) with the early maturity, large boll and high ginning outturn of the Uplands. The lines most outstanding in these respects were chosen from each type and over thirty combinations made in 1929, involving over 100,000 crosses. The F_1's displayed very marked hybrid vigour and were remarkably luxuriant. The characters are tabulated. The hybrids, without exception, showed an increased boll production and a diminution in shedding, with a consequent increase in lint yield approaching and sometimes exceeding that of the Upland parent. In time of ripening the hybrids were intermediate, some being seven days earlier than the standard sort, Navrotskii. In frost resistance they were superior to both parents, and could therefore be sown earlier, over ten days earlier than the Uplands. The lint length was also intermediate, as also the thickness and tensile strength. The hybrids were very satisfactory in spinning quality, and contained considerably higher percentage of oil. The percentage of cellulose in the fibres was somewhat higher and of salts somewhat lower in the hybrids. Greatly improved methods of effecting the crosses have been elaborated. By just bringing together the flowers of each sort without previous emasculation a large quantity of crosses can be made in the time, but a high proportion of self-pollination occurs. A better method consists in emasculating in the evening those flowers about to open the following day, pollinating them on the following morning with flowers of the male parent, one flower of which will serve to pollinate six to ten flowers. The work of emasculation can be continued in the early hours of the morning. The removal of a certain number of flowers markedly reduces the loss by shedding. The seeds are sown at the rate of 20 kg. per hectare. The hybrid plants can be propagated vegetatively by grafting individual monopodia, entire sympodia, the main stem, roots or even individual leaves; and the plants or parts of plants can be kept alive during the winter and the plant used thus as a perennial. The two-year-old plants give much higher yields than the one-year-old. The methods of vegetative propagation, transplantation, etc., are described. These methods are being tried out on a large scale.

122. GRAFTING EXPERIMENTS WITH COTTON. By H. E. Rea. (*Plant Physiol.*, 6, **1**, 1931. Abstr. from *Exp. Sta. Rec.*, 67, **5**, 1932, p. 509.) The author describes a method of asexual propagation of cotton plants that is considered adapted to the indefinite retention of parental types. By the use of the saddle-grafting method 70 per cent. of the grafts were successful if made prior to 9 a.m., while very few grew when grafted during the heat of the day. A delay of one hour in placing the scion after it was cut reduced the percentage of success.

123. THE SHEDDING OF 4-LOCK AND 5-LOCK BOLLS IN UPLAND COTTON. By R. E. Beckett and J. W. Hubbard. (*U.S. Dpt. Agr. Tech. Bull., No* 277, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 33.) Studies made with Lone Star cotton at Greenville, Texas, in 1925, and with Acala cotton at Bard, California, in 1926 and 1927, showed that 5-lock bolls may have a greater tendency to abort than 4-lock bolls. The data obtained under favourable and unfavourable conditions demonstrated that under adverse conditions a lower percentage of 5-lock bolls are produced and a higher percentage are shed.

124. ZAKNIHI, ITS OBJECTS AND ATTAINMENTS. By G. P. Dzhevarlinsky. (*Bull. Zaknihi, Popular Sci. Ser.*, xxi., 1932. From *Plant Breeding Abstracts*, iii., **1**, 1932, p. 28.) The section of breeding and genetics is concerned with increasing the productivity and quality of cotton and the rotation crops "by selection

and production of new sorts by the methods of analytical and synthetic breeding." The programme consists of examining the world collection and obtaining those of practical interest by selection and crossing of pure lines. Strains of cotton suitable for Transcaucasia are desired, and ultra-early strains for new cotton regions.

125. COTTON SEED: ANATOMY AND MICROCHEMISTRY. By R. G. Reeves and C. C. Valle. (*Brit. Chem. Abs. A.*, 1932, p. 784. Abstr. from *Summ. of Curr. Lit.*, xii., **19**, 1932, p. 536.) In addition to oil and protein, traces of starch occur occasionally in both young and mature embryos of cotton seed. Pentosans are located in the resin glands. Cell walls consist chiefly of cellulose. In the endosperm tissue, starch, oil, and protein are present. Considerable proportions of starch exist in the two integuments of the developing ovule, but disappear before maturity. The cell wall of the perisperm and the colourless layer become lignified before maturity, and those of the pigmented layer are of lignocellulose. The palisade layer of the seed-coat contains cellulose and lignocellulose.

FIBRE, YARN, SPINNING, WEAVING, ETC.

126. IMPROVEMENTS IN COTTON OPENING. (*Man. Guar. Coml.*, Oct. 29, 1932.) Describes an entirely new design of cotton opener recently introduced by a firm of Lancashire textile machinists.

127. COTTON: CHARACTERIZATION BY SOLUBILITY CURVES. By V. Shinoda. (*J. Soc. Chem. Ind.*, Japan, **35**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **21**, 1932, p. 591.) The dependence of the solubility of cotton in cupra-ammonium solution on the alkali concentration and on the copper concentration has been investigated for various American, Egyptian, African, Indian, Chinese, and Korean cottons. The solubility-copper concentration curves may be used for the characterization of the different cottons.

128. THE MEASUREMENT OF FIBRE LENGTH. By W. Sever. (*Text. Rec.*, l., **592**, 1932, p. 21.) Describes an instrument recently devised for the purpose Leeds University.

129. VARIATION IN THE PROPERTIES OF COTTON FIBRE IN RELATION TO ITS POSITION ON THE SURFACE OF THE SEED. PT. 1. (i) FIBRE-LENGTH; (ii) FIBRE-WEIGHT; (iii) FIBRE-STRENGTH. By R. S. Koshal and N. Ahmad. (*Tech. Bull.*, Ser. B, No. 14, *Ind. Cent. Cott. Comm.*, 1932.) *Summary.*—The experiments described relate to the following fibre-properties in relation to the position of the fibres on the surface of the seed: (i) fibre-length; (ii) fibre-weight; (iii) fibre-strength. The material consisted of a single seed of Surat 1,027, A.L.F., and groups of 200 seeds of six Standard Indian cottons, two of which were also tested for two seasons. The lint was obtained from the following regions of the seed: (1) The apex or the pointed end; (2) the base or the butt end; (3) the right flank; (4) the left flank; and (5) the hairs removed in gentle combing by hand—"the combed hairs." The position of the point of rupture in a single hair-break was also examined by mounting fibres between two types of eyelets, one made of brass and the other of aluminium, the former attached to the basal position and the latter to the apical position of the fibre.

From a study of the graphs and an analysis of the test results the following conclusions have been drawn:

(1) The frequency distribution of fibre-length is approximately symmetrical and normal, not only for fibres taken from the whole seed but also for fibres taken from different regions of the seed.

(2) The mean fibre-length for fibres at the base of the seed is significantly

greater than for fibres at the apex of the seed, indicating that the basal fibres are longer than the apical ones.

(3) Not only is the asymmetrical distribution of fibre-strength a characteristic of all fibres from the seed, but also, in the different regions of the seed, the distribution of fibre-strength is definitely skew.

(4) The mean fibre-weight per unit length and the mean fibre-strength are significantly higher for the apical than for the basal fibres.

(5) The values of the mean fibre-lengths, the fibre-length distribution, fibre-weight, and fibre-strength are practically the same for the right and the left flanks —the small differences observed between them are well within the sampling error.

(6) The fibres which are removed in the process of combing the seed by hand are generally those which have got the least fibre-weight.

(7) For the majority of fibres (about 80 per cent.) the point of rupture in single hair-breaks is located in the *apical portion* of the fibre. There is a low correlation between the point of break and strength, indicating that there is a tendency for the comparatively weak fibres to break near their apical ends.

(8) The percentage differences between base and apex mean values of the various fibre-properties are different for different cottons. A table is included which gives in summary form the mean values and the percentage differences for the eight cottons which formed the subject of this investigation.

(9) There is a distinct tendency for a high ginning percentage to be associated with low percentage difference between mean fibre-length of hairs taken from the apex and base of a seed.

The practical applications of the investigation are discussed.

130. Old and New Cotton Fibres: Differentiation. By A. W. Winne and J. D. Donovan. (*Melliand Text. Monthly*, **4**, 1932, p. 298. Abstr. from *Summ. of Curr. Lit.*, xii., **21**, 1932, p. 592.) The possibility of distinguishing between old and new cotton fibre by means of ultra-violet light has been explored. This method is sometimes conclusive, particularly when the material is either all old or all new, but should not be relied on alone for correct results if new and old materials are mixed as by garnetting. In this case tests should be made for the presence of oxycellulose and for damage to the fibre by heat, fungi, or mechanical means. The Congo Red test is mentioned.

131. Staple Fibre Cutting Device. By H. Dreyfus. (*Russa.*, **7**, 1932. Abstr. from *J. of Text. Inst.*, xxiii., **9**, 1932, A485.) Describes apparatus in which filaments are carried to rotating cutting discs by a series of endless bands arranged so that the discs rotate in the spaces between individual bands.

132. Cotton Hair: Microscopy. By R. N. Titus *et al.* (Reprint from *J. Chem. Ed.*, **9**, 1932, p. 114. Abstr. from *Summ. of Curr. Lit.*, xii., **13**, 1932, p. 380.) A short account is given of the growth and structure of the cotton hair. The formation of "dead hairs," the cause of the spiral structure, the porosity of the hair, and the desiccation of the cellulose are discussed. The paper is essentially a summary of the work of Balls, the British Cotton Industry Research Association, and others on this subject.

133. Cotton Neps: Causes. Southern Textile Association. ((1) *Cotton* U.S., xcvi., **6**, 1932, p. 39; (2) *Ibid.*, p. 45. Abstr. from *J. of Text. Inst.*, xxiii., **9**, 1932, A483.) (1) The causes of neps are discussed, and it is claimed that these may be produced in scutching as well as in carding. The need for careful attention to setting, stripping, and grinding is emphasized. (2) A discussion of the influence of speeds, settings, the condition of the wires, the variety of cotton, and the humidity, on the formation of neps, and of various attempts to eliminate this trouble.

134. Cotton Yarn: Basis Transaction in Japan. (*Ind. Text. J.*, **42**, 1932, p. 330. Abstr. from *Summ. of Curr. Lit.*, xii., **12**, 1932, p. 547.) Basis transaction of cotton yarn which is being adopted in Japan has been defined as follows: (1) In this new method one party buys from another party a certain quantity of yarn to be delivered during a certain month, and so far nothing is different from ordinary forward business. In this basis transaction price is not fixed, but only quantity, month for delivery and price difference on the price to be publicly fixed by Sampin Exchange (exchange for cotton and yarn) in forward transactions for that fixed month. (2) After the transaction is closed, the seller will at his convenience sell the same quantity of yarn in forward delivery corresponding to the stipulation of the contract in Osaka Sampin Exchange. The price at which the latter party bought fixes the price of the yarn contracted in (1), and the buyer shall make his purchase through the broker specified by the seller, by the name of the seller, before 25th of preceding month of delivery month of the contract. The spinning mill, in this kind of contract, sells to yarn dealers forward goods, fixing counts, brand, quantity, month of delivery and basis on the price to be fixed by the exchange for that month—*i.e.*, the parties fix basis only instead of contract price which is to be fixed later. An example is given, and the advantages of this system are discussed. Spinning companies can sell under basis contract forward goods in exchange, taking the most profitable chance when cost of cotton and price of yarn yield most profit to them, and buying cotton at the same time and thus insuring the profit. Yarn dealers can easily purchase the required quantity of a certain brand free from the risk of price fluctuation if they adopt this system. The system also protects weavers from various inconveniences and risks. The fluctuation of basis in the case of 44s/2. is discussed.

135. The Shrinkage of Cotton Yarn and the Viscosity of its Solutions in Aqueous Caustic Soda—Cuprammonium Hydroxide. By S. M. Neale and W. A. Stringfellow. (*J. of Text. Inst.*, xxiii., **8**, 1932, T177.) The shrinkage of cotton yarn in mixed solutions of sodium hydroxide and cuprammonium hydroxide shows a maximum value at concentrations of sodium hydroxide between 0·1 N and 0·3 N. This maximum becomes very sharp and pronounced for concentrations of cuprammonium hydroxide within the range 0·05 to 0·1 N. Solutions obtained by dissolving the cotton yarn in sodium hydroxide-cuprammonium mixtures containing a still higher proportion of the latter constituent show no marked change in viscosity over the range of sodium hydroxide concentrations in which the observed variations in shrinkage occur.

136. The Moisture Relations of Cotton: The Effect of Processing. By A. R. Urquhart *et al.* (*J. of Text. Inst.*, xxiii, **7**, 1932, T135.)

137. Easy Control of Moisture Content in Cotton Bales. By W. L. Balls. (*Int. Cott. Bull.*, x., **39**, 1932, p. 391.) A testing house has been established in Alexandria for examining and certifying the moisture content of exported cotton bales. Under the circumstances obtaining in the pressing establishments it is simpler to obtain the necessary samples by taking them as the cotton enters the press than by breaking bales already pressed, which is the procedure employed in the countries of destination. But even so, the method is tedious, since it entails carrying each sample to the testing house, weighing, drying, and weighing again repeatedly. This method, with many appropriate precautions, is the standard one throughout the world; even with highly developed organization, an average of two hours elapses between making the bale and getting the test result at the press, while only a fraction of the total output can be represented.

The author has developed a method which can inform an observer at the pressage in only a few seconds whether any bale passing before him is of the agreed moisture content (8 to 9 per cent.) or not.

The general idea of operations with the new device is that an observer attached to the testing house would apply it to each bale coming out of the press. The application would consist of dropping a rod into contact with the bale, moving a switch, and watching an indicating dial. If the movement of a pointer on the dial did not exceed certain limits the bale would be marked as O.K. If it indicated excess or deficit of water the difference could either be estimated on the spot by the same instrument or, more easily, the bale could be set aside for further examination by a duplicate instrument and/or by sampling, drying, and weighing. The same sworn observer could simultaneously certify the bale weight, and thus one testing-house official could control every single bale sent out from one press.

138. Raw Cotton and Tissue Paper: Moisture Adsorption. By S. Oguri. (*J. Soc. Chem. Ind., Japan* [Suppl.], **35**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **20**, 1932, p. 563.) Adsorption isotherms and isohygrometric curves are given for raw cotton and tissue paper, and compared with the data obtained previously for standard cellulose. Raw cotton and tissue paper adsorb almost equal amounts of moisture under the same conditions, and are more hygroscopic than standard cotton cellulose.

139. Cotton: Oil Spraying. Southern Textile Association. (*Cotton*, U.S., 96, **6**, 1932. Abstr. from *J. of Text. Inst.*, xxiii., **9**, 1932, A482.) Better running work, firmer products, and reductions in waste, dust, and fly, are reported as a result of spraying the cotton with oil at the point where the Kirschner beater takes it from the feed rollers; 0·3 per cent. of oil is used. A little more trouble is experienced with hard ends and the cotton seems to be harder to draft on the fly frames.

[*Cf.* Abstr. **66**, Vol. IX., p. 83.]

140. Cotton Mill Costing System. By S. Chadwick. (*Text. Weekly*, **9**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **18**, 1932, p. 520.) A "predetermined normal costs method" is described, and its various elements are analyzed.

141. Cotton Mill Costing System: Application. By E. G. Field. (*Cotton*, U.S., xcvi., **5**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **14**, 1932, p. 425.) A discussion of the need for careful cost determinations, and their value to the management for the control of selling policy. The problems under review include that of the effect of working overtime on costs and profits.

142. Cotton Mill Labour: Effects of Changes in Methods of Production. (*Text. Weekly*, **9**, 1932, p. 545. Abstr. from *Summ. of Curr. Lit.*, xii., **18**, 1932, p. 521.) A review of the Board of Trade "Industrial Survey of the Lancashire Area," prepared by E. M. Gray and others at Manchester University. Particulars are included of the redistribution of machines and operatives consequent on a mill changing from mule spinning to high-draft ring spinning. The "more looms" system has also been investigated.

143. New Uses for Cotton. (*Int. Cott. Bull.*, x., **40**, 1932, p. 600.) Among the new uses for cotton suggested by the Cotton Textile Institute of New York are cotton panama hats, made from a cotton braid three-eighths of an inch wide, and cotton suits for men made of a pre-shrunk fabric.

144. Cotton for Roads. (*Chem. and Ind.*, vol. l., **27**, 1932, p. 577. Abstr. from *Trop. Agriculture*, ix., **9**, 1932, p. 295.) According to the *Contract Journal*, a new use has been found for cotton fabrics. It is stated that at the present time, whenever it is necessary to mend the roads, not only the surface but the sub-surface and even the very foundations have to be dug up. By inserting a layer of cotton fabric between the surface of the road and the sub-surface, it is possible, when the roadway becomes worn, to flake off the upper surface, without disturbing the foundations. For this purpose a cheap cotton fabric can be used, similar to that used to protect meat.

145. Cotton for Airships. (*Int. Cott. Bull.*, x., **40**, 1932, p. 599.) The huge airship "Macon," the U.S. Navy's newest dirigible, will wing its way through the air on 92,000 square yards of cotton. For the outer covering 36,000 square yards of cotton fabric have been used. From its silvery look the covering appears to be of metal, but the metallic sheen results from treatment of the cotton fabric with four coats of acetate cellulose mixture, two of them containing aluminium powder. This treatment tightens the fabric over the frame, gives it smoothness and waterproof qualities, and deflects the sun's rays. For the gas cells 56,000 square yards of rubberized cotton fabric have been used. The fabric for the outer covering weighs only three ounces per square yard, and for the gas cells, two ounces.

146. Creaseless Cotton. (*Text. Rec.*, vol. l., **593**, 1932, p. 22.) The scientific staff of Tootal Broadhurst Lee Co., Ltd., have evolved a method of finishing cotton and rayon goods whereby they are given valuable anti-crease properties.

147. Cotton Stalks: Value for Paper Making. Vidal, Brot, *et al.* (*Coton et Cult. Coton.*, **7**, 1932, p. 1. Abstr. from *Summ. of Curr. Lit.*, xii., **20**, 1932, p. 549.) The results of microscopic and micro-chemical studies of cotton stalks, and paper pulps prepared from them by methods involving the use of alkali of different concentrations, are described. The yield of cellulose from cotton stalks amounts only to 35 per cent. A bleached pulp suitable for the manufacture of fine paper can be obtained by treatment with alkali of medium concentration. The majority of the fibres in the pulp, however, are short and of low felting power, and the produce is useful chiefly for filling purposes. The yield of bleached pulp is low compared with that from straw. Unbleached pulp can only be used for the manufacture of wrapping paper, and even for this purpose its value is low, as the fibres are short and of low strength.

148. The World Textile Industry. By A. Niemeyer. (*Text. Rec.*, vol. l., **592**, 1932, p. 34.) Discusses the causes of the world textile crisis.

149. Is the World Textile Industry at the Turning-Point? By A. Niemeyer. (*Text. Rec.*, l., **595**, 1932, p. 34.) A useful discussion of the present situation in Great Britain, France, Switzerland, Austria, Poland, United States, and Japan. In the author's view the crisis has been reached, and there are signs of a general improvement.

150. Ten Years of Cotton Textiles. (*Int. Cott. Bull.*, x., **40**, 1932, p. 581.) An interesting survey of the cotton textile industry in the United States during the past decade, published by the Association of Cotton Textile Merchants of New York.

151. World Textiles: With a Review of American Cotton. (Pubd. by *Man. Guard. Coml.*, October 1, 1932.) Contains, among others, the following interesting articles: "American Cotton in 1931-32" (Fooshe); "Weather and Weevils" (G. D. Smith); "Lancashire's Success in Scandinavia" (E. Brennan); "A Bid for Better Trade with South America"; "Improvements in Textile Machinery" (W. A. Hanton).

152. The Significance of Results in Textile Testing. By F. P. Slater. (*J. of Text. Inst.*, xxiii., **7**, 1932, p. 170.) Discusses the subject under the following heads: Real Variations in the Material; Sampling for Tests; Observations on Testing Apparatus; Corroborative Methods; Difficulties in Obtaining Decisive Results; Samples for Testing.

153. Textile Research within the Empire. By A. C. Goodings. (*Canad. Text J.*, **49**, **15**, 1932. Abstr. from *J. of Text. Inst.*, xxiii., **9**, 1932, A528.) A survey of the problems under investigation within the Empire.

154. Research in the British Cotton Industry. By Dr. R. H. Pickard (*Cotton*, M/c., xxxviii., **1838**, 1932, p 21.) An interesting account of the work of

the Shirley Institute, showing its cumulative value over the years. Very successful results have been obtained from the use of the "Combined Stapling Test."

155. THE BRITISH TEXTILE EXHIBITION. (*Text. Rec.*, vol. l., **594**, 1932, p. 67.) The British Textiles Exhibition, as a section of the British Industries Fair, will open at the White City in February next. The Textile Section will occupy 15,000 sq. ft. more than was required for the display last February. Every section will be larger and more representative, and in each the outstanding feature will be the advance in the standard of production, design and finish.

TRADE, CO-OPERATION, ETC.

156. THE IMPERIAL ECONOMIC CONFERENCE AT OTTAWA. (*Text. Rec.*, vol. l., **594**, 1931, p. 30.) The report of the cotton trade delegation makes specific reference to those Empire countries in which Lancashire cotton spinners and manufacturers have trading interests—*viz.*, India, Australia, New Zealand, South Africa, and Canada.

157. COTTON: PRICE FLUCTUATIONS. (*Man. Guard. Commil.*, **24**, 1932, p. 407. Abstr. from *Summ. of Curr. Lit.*, xii., **13**, 1932, p. 399.) The application of the Wallis method to the determination of the price fluctuations of cotton is described. The method depends on the theory that cost of production ultimately determines the price. The estimates of commodity prices are based on "normal price," which is the value produced per person per annum. This "normal price" moves sympathetically for all commodities. In the case of cotton production it is assumed that the number of persons employed per acre remains constant from one census to the next, and the "normal price" is obtained by multiplying the yield per acre by the average price obtained. To find the money or market price of a crop it is necessary to know the yield per acre for the season, and the production of gold per person for the previous year. If the gold production figures are not available a composite normal price-level is made up of coal, cotton, wheat and maize figures. The market or money price is then obtained by dividing the gold or composite normal price by the yield per acre. Estimated and actual prices for American cotton are given for the period 1904-17.

158. COTTON STATISTICS. (*Text. Rec.*, vol. l., **594**, 1932, p. 75.) The International Federation of Master Cotton Spinners' and Manufacturers' Associations have published a booklet of international cotton statistics which gives the consumption of cotton for the half-year ended July 31, 1932, and stocks of cotton in spinners' hands on August 1, 1932, with previous figures for comparison.

159. HANDBOOK OF COTTON TRADE STATISTICS, 1924-31. (Manchester: Cotton Trade Stat. Bur. Abstr. from *Text. Rec.*, vol. l., **594**, 1932, p. 72.) This handbook is intended to supplement the information given in the monthly and quarterly bulletins of the Cotton Trade Statistical Bureau. The three sections deal respectively with: Raw cotton; production and activity; world trade in cotton goods. The first section comprises tables of exports of raw cotton from the United States, Egypt, and British India to importing countries between 1924 and 1931, and imports of raw cotton into the United Kingdom, Japan, United States, India, China, Canada, etc. The second section comprises statistical data relating to yarn and cloth production, and employment and activity in the world cotton industry. The third section covers exports of cotton manufactures and yarns, and export and imports of cotton piece-goods and miscellaneous manufactures. Most of the tables cover the period 1924-31, but for the United Kingdom figures have been given for 1909-13 and the whole of the post-war years. The handbook is of convenient size and should prove of value to those engaged in the cotton industry.

MISCELLANEOUS.

160. REPORT BY MR. F. A. STOCKDALE, C.M.G., C.B.E., AGRICULTURAL ADVISER TO THE SECRETARY OF STATE FOR THE COLONIES, ON HIS VISIT TO THE WEST

INDIES, BERMUDA, BRITISH GUIANA, AND BRITISH HONDURAS, 1932. (C.A.C. 128.) A very interesting report on a visit made to the West Indian area in order to discuss with the authorities of the Imperial College of Tropical Agriculture in Trinidad the work of the College, and then to ascertain the present-day conditions of the agricultural industries in the several Colonies, and study the work carried out by the different Departments of Agriculture to assist these industries.

The market position in the West Indies with regard to cotton is said to be difficult owing to the reduced demand for Sea Island. Mr. Stockdale is of opinion that if the West Indies will form a Growers' Association, responsible for standardization of the quality of exports and quota restrictions where necessary, and if a determined effort be made by those interested in cotton to work for an increased consumption of Sea Island in the United Kingdom and elsewhere, it should be possible to effect a very material improvement in the present position.

161. STUDIES IN TROPICAL LAND TENURE. By H. M. Leake. (*Trop. Agriculture*, ix., *Nos.* 9, 10, *and* 11, 1932.) These papers deal with the land tenure systems in the West Indies, the Eastern Colonies (Malaya and Ceylon), and East Africa.

162. REPORTS ON THE WORK OF AGRICULTURAL RESEARCH INSTITUTES AND ON CERTAIN OTHER AGRICULTURAL INVESTIGATIONS IN THE UNITED KINGDOM, 1930-31. (Min. of Agr. and Fisheries, London, 1932.) Contains summaries of the work in progress at Agricultural Research Institutes in the United Kingdom and Northern Ireland. An addition has been made by the insertion at the end of each report of a numbered list of the papers published during the year by each Institute or research centre; references to the numbers of these papers will be found in the text. These lists take the place of the annual volumes of *Abstracts of Papers on Agricultural Research in the United Kingdom*, publication of which has been discontinued. A list of the names and addresses of Directors of Research Institutes and persons in charge of investigations at other centres is given in the Appendix.

163. INTRODUCTION TO AGRICULTURAL BIOCHEMISTRY. By R. A. Dutcher and D. E. Haley. (John Wiley and Sons, New York, or Chapman and Hall, London, 1932, price 28s. Abstr. from *Trop. Agriculture*, ix., **11**, 1932, p. 353.) This textbook is an ambitious attempt to survey the whole domain of agricultural chemistry. It is divided into three parts: the first deals with general matters, such as the history of agricultural chemistry, the classification of the chief chemical compounds that occur in plants and animals, and the physical states of matter. The second part deals with the plant, and includes chapters on seed germination, the chemistry of the soil and the atmosphere, manures and insecticides, the absorption and assimilation processes of the plant, the synthesis of carbohydrates, proteins and fats, and plant respiration. The last part deals with the animal, under the headings: foods, their nature and digestion; body tissues, their kinds and their metabolic changes; and the five chief vitamins, which are considered in turn, each in a separate chapter.

ADDENDA.

164. NIGERIA: COTTON CULTIVATION. (*Half-yearly Rpt. of Dpt. of Agr. to September* 30, 1932.) *Northern Provinces.*—The exports of American cotton for the 1931-32 season amounted to 4,811 bales, a considerably less amount than that of the previous season. The demand for seed for the 1932-33 season exceeded the supply, but it is not believed that planting has been restricted to any very great extent. The supply probably nearly met the demand, and it is hoped that the available seed has been used rather more economically than is generally the case. At the time of planting a prolonged drought was experienced, which

resulted in a larger proportion of the crop than usual being sown late. The rainfall in August and September, however, was moderate and uniformly distributed, and there was less temporary partial waterlogging of the heavier soils than occurs in most years. Furthermore, the rainfall in October—which is very variable, and which has always been observed to have very great influence on the yield per acre—has been very satisfactory this year, and the yield per acre accordingly promises to be above normal. A crop of some 20,000 bales is anticipated, which shows a considerable increase over last season.

Southern Provinces.—Low prices paid for the 1930-31 crop caused a considerably reduced acreage to be planted to cotton in 1931-32. As the result of the new grading regulations, the percentage of first-grade Ishan cotton was much lower than in previous years. Grading in the early part of the season was badly done, partly because examiners were unfamiliar with the new grades, and partly through shortage of supervisory staff. Examiners were suspected of receiving bribes, though that could not be proved. Six of them were dismissed, and several others heavily fined; after this the grading became satisfactory. In the 1932-33 season Ishan cotton seed was again sold at ½d. per lb. Some 25 tons were purchased, as compared with 57 tons in the previous year. While the low prices obtained for seed cotton were partly responsible for this decrease, it was also due to the exceptional lack of rain before and at the time of planting. Rainfall at Ibadan in July was 2·20 inches, as compared with an average of 6·23 inches in the last twenty-one years. Continued dry weather after planting further delayed the crop, and it was not until October that matters improved. At the time of writing (November) the cotton is looking quite promising.

165. Indian Cotton Prospects. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of their *Indian Cotton Review* for the season 1931-32, from which we quote the following: " Out of a total world consumption of 4,701,000 bales of Indian cotton for the twelve months ending 31st July last, the consumption outside India was approximately 2,378,000 bales. But the total exports from India during the twelve months ending 31st July, 1932, were 1,720,000 bales; therefore, they were compelled to encroach on their previous carry-over to the extent of 658,000 bales. The net result is that on the 1st August, 1932, the stock of Indian cotton outside India was less than last year at the same time by 658,000 bales. In spite, therefore, of the increase in the stock of raw cotton in India, the total world stock of Indian cotton is very small. The world carry-over of Indian cotton as on 1st September, 1932, was 1,625,000 bales, compared with 1,930,000 bales on the same date in 1931, 2,120,000 bales in 1930, 2,225,000 bales in 1929, and 2,500,000 bales in 1928. No further proof from the point of view of carry-over is necessary to emphasize the potential soundness of Indian cotton." It is stated that world spinners cannot afford to do without Indian cotton altogether, and the export demand for it must necessarily increase in view of the fact that stocks with foreign spinners are very low at present, and with a recovery in general world trade conditions the demand for Indian cotton will rapidly increase.

166. Mysore. *Cotton Cultivation.* (*Rpt. of Agr. Dpt., Mysore,* 1931.) The work on cotton at the Babbur Farm has progressed satisfactorily. The cultivation of Selection 69 of Sannahatti (Kumpta) is still spreading, but the Senior Assistant Botanist has developed a number of hybrids between different species of Indian cottons, some of which appear to be superior to Selection 69. The work in connection with the breeding of wilt-resistant cottons has been continued, and two promising strains have been isolated. Work is also under way on the hybridization of Indian cottons and American cottons with a view to evolving strains of good staple and high ginning outturn suitable for Mysore conditions.

PERSONAL NOTES

We have to announce with much regret the death at Brighton, on October 14, of Sir William Hepworth Mercer. Sir William Hepworth Mercer had represented the Colonial Office on the Board of Trustees of the Corporation since its inception.

We also announce with much regret the death of Mr. Tom Garnett, which occurred at his home at St. Leonards-on-Sea on September 29. Mr. Garnett had been a member of the Corporation since 1922.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

Ceylon	Mr. G. Harboard.
Gold Coast	Mr. J. E. Symond.
Nigeria	Mr. O. B. Lean.
,, ...	Mr. V. F. Olivier.
Nyasaland	Mr. E. Lawrence.
Sierra Leone	Mr. M. Vardry.
Tanganyika Territory	Mr. G. S. Brown.
,, ,, ...	Mr. B. E. Eustace.
,, ,, ...	Mr. C. K. Latham.
,, ,, ...	Mr. L. Leslie-Moore.
,, ,, ...	Mr. F. R. Sanders.
,, ,, ...	Mr. A. Taylor.
,, ,, ...	Mr. N. H. Vicars-Harris.
Uganda	Mr. N. S. Haig.
,, ...	Mr. L. W. Raymond.

PRINTED IN GREAT BRITAIN BY
BILLING AND SONS LTD., GUILDFORD AND ESHER

THE
EMPIRE COTTON GROWING
REVIEW

VOL. X. APRIL, 1933. No. 2

THE WORLD'S COTTON SUPPLIES
WHY EMPIRE COTTON IS STILL NEEDED

BY

JOHN A. TODD, M.A., B.L.

THE cotton trade has always been notorious for the extreme fluctuations of supply, consumption and prices from which it suffers; and the developments of the last three years, since the Wall Street crash of October, 1929, have provided one of the most notable contrasts in the whole of its history. The world's Carryover of American cotton at July 31, 1932, reached the unprecedented total of 12,802,000 bales against a pre-war normal figure of about 3,500,000 bales; and that was a record in more ways than one, because for the first time probably in history the Carryover was substantially more than the world's consumption of American during the preceding season, which, according to the International Federation, was 12,316,000 bales against a pre-war normal of fully fourteen millions. Such a comparison obviously makes it necessary to take stock of the whole position of world cotton supplies, with special reference to the relative parts played in these supplies by the American crop and by Outside Growths in the widest sense of the term—*i.e.*, including everything except American. The question obviously has a particular bearing on Empire cotton.

A convenient period for a survey of the modern history of the cotton trade is the last thirty years, which, as it happens, coincides with the foundation of the British Cotton Growing Association in 1902, and the point of the survey is to note how far the arguments which were put forward for the establishment of the Association, and of similar associations in other countries, have been justified by the event. These arguments were:

(1) That the world's cotton supplies were not increasing as fast

as the potential demand for cotton, with the result that prices were rising unduly.

(2) That the American crop fluctuated in a most undesirable way, as expressed in the old Lancashire maxim that a big crop is always followed by a small one and *vice versa*. At that time it was assumed that this was mainly due to the vagaries of the American climate, and it was therefore obviously desirable that the world's supplies of cotton should be spread over a much wider area, so that the risks of the climate in one quarter of the globe might be offset by different conditions in other parts where cotton could be grown.

(3) It was felt, not only by ourselves but by the other European Powers with new colonial possessions, that these offered great possibilities for the development of cotton-growing, which would not only be to the advantage of the industry as a whole, but also very much to the advantage of the colonies.

These arguments were very strongly reinforced in the first year of the Association's existence by "Sully's Corner," which was rendered possible by the comparatively small American crop in 1903, and which drove American cotton up to what was then thought the impossible price of 8·96d.

The history of the world's cotton supplies from 1902 till the war amply justified all these arguments. The American crop continued to fluctuate as badly as ever, and it began to be evident that this was not entirely due to climatic vagaries, but was the result of the establishment of a vicious circle. A big crop followed by lower prices produced a reduction in the acreage next year, because many of the planters were working very close to the margin of profitable cultivation. Other things being equal, that meant a smaller crop and higher prices, and this was followed by a bigger acreage again in the third year. At the same time the rapid spread of the boll weevil was beginning to result in a definite reduction of the average yield per acre in a large part of the Belt, with the result that the cost of production per pound was rising, and it was evident that the weevil would soon cover practically the whole Belt. At the same time the rapid development of the cotton manufacturing industry in the United States was emphasizing the danger of increased world's consumption, which was clearly brought out by the fact that America's share in the consumption of her own crop was on the whole rising steadily. On the other hand, the efforts to develop cotton-growing outside the United States were meeting with gratifying success, and from 1902 to 1914 the total supply of Outside Growths was nearly doubled.

The war, of course, produced entirely abnormal conditions. The

world's cotton production was seriously reduced, but owing to the blockade consumption was still further restricted and the shortage of supplies during the war period was largely a question of difficulties of transport.

When the war was over it was hoped that conditions would quickly return to normal, but the old vicious circle came into play again. The post-armistice slump in prices resulted in a definite reduction of acreage in 1919 and, climatic conditions in America being unfavourable, the crop of that year was comparatively small. On top of this came the post-war boom, with the result that prices rose to unprecedented figures. The acreage quickly recovered and the American crop of 1920 was the largest since the war; but before it came to market the boom had broken and the slump in cotton prices was even more dramatic than the rise. The result was again a heavy reduction of acreage all over the world in 1921, and on top of this boll weevil damage in America reached its peak and for three years it looked as if the American crop was going to be almost wiped out altogether. Then the crop staged another miraculous come-back. For three years the boll weevil almost disappeared and the crop figures mounted steadily to a new record in 1926. Once more the pendulum swung again, and from 1927 to 1930 the American crop was below pre-war figures. But just when we were beginning to settle down to the conviction that 1926 had been an accident, America again astonished the world by producing the highest average yield since pre-weevil days, and the crop of 1931 was only prevented from being a new record by the reduced acreage. 1932 failed to repeat the miracle, but the latest reports show that the yield per acre will still be above the ten years' average.

The essential facts of the whole period are shown in the following table, which gives the world's total supplies and the allocation of these between the American crop and Outside Growths, with the American figure shown as a percentage of the world's total. The Consumption figures are also shown, giving the world's total consumption (*a*) of all kinds of cotton and (*b*) of American, and separately, the consumption of American cotton in the U.S.A., shown as a percentage of the crop.

These two percentages bring out very clearly the main tendencies of the period, namely (1) the diminishing percentage of the world's total provided by the American crop, and (2) the increasing percentage of its own crop which America has been using; and to show the whole position at a glance these two percentages are plotted on the accompanying diagram. In order to bring out the very high

negative correlation between the two, America's percentage consumption is shown reversed. This is in accordance with the facts, because America's consumption throughout the period has, on the whole, risen steadily, regardless of the fluctuations of the crop.

WORLD'S COTTON CROPS AND CONSUMPTION.

(000's OMITTED. EXCLUDING LINTERS THROUGHOUT.)

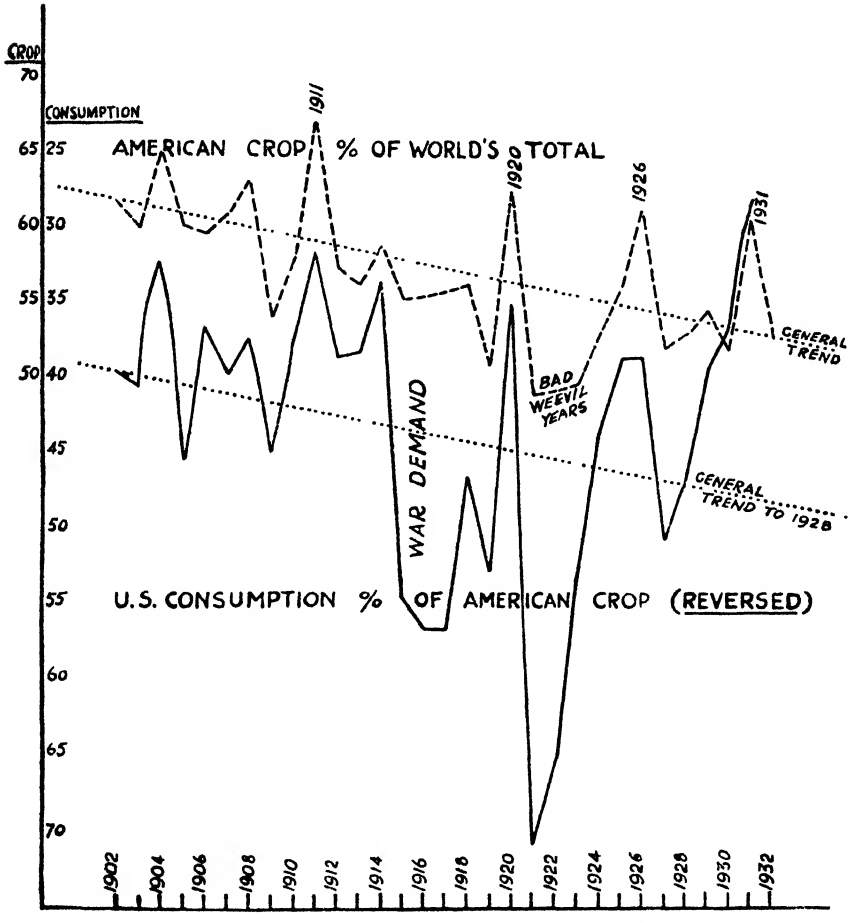
Season.	*World's Crops.*	*American.*	*Percentage of Total.*	*Outside Growths.*	*Federation Mill Consumption.**		*U.S.A. (American).*	*Percentage of Crop.*
					World (All Kinds).	*World (American).*		
1902–03	17,109	10,631	*62·1*	6,478	—	—	4,187	*39·4*
1903–04	16,342	9,851	*60 3*	6,491	—	—	3,981	*40·4*
1904–05	20,587	13,438	*65 3*	7,149	—	—	4,279	*31·8*
1905–06	17,513	10,575	*60 4*	6,938	19,347	12,156	4,809	*45·5*
1906–07	22,190	13,274	*59·8*	8,916	19,878	12,716	4,845	*36·5*
1907–08	18,165	11,107	*61·1*	7,058	20,071	12,658	4,389	*39·5*
1908–09	20,840	13,242	*63·5*	7,598	20,429	12,703	4,930	*37·2*
1909–10	18,375	10,005	*54·4*	8,370	19,662	11,796	4,466	*44·6*
1910–11	19,961	11,609	*58·2*	8,352	20,889	12,056	4,323	*37·2*
1911–12	23,390	15,693	*67·1*	7,697	22,915	14,431	4,922	*31·4*
1912–13	23,836	13,703	*57·5*	10,133	22,967	14,153	5,250	*38·3*
1913–14	25,049	14,156	*56·5*	10,893			5,383	*38·0*
1914–15	27,355	16,135	*59·0*	11,220	Not compiled		5,375	*33·3*
1915–16	20,165	11,192	*55·5*	8,973	during the		6,081	*54·3*
1916–17	20,552	11,450	*55·7*	9,102	war		6,470	*56·5*
1917–18	20,169	11,302	*56 0*	8,867			6,383	*56·5*
1918–19	21,314	12,041	*56·5*	9,273			5,590	*46·4*
1919–20	22,305	11,421	*51·2*	10,894	19,110	12,437	6,003	*52·6*
1920–21	21,467	13,440	*62·6*	8,027	17,946	10,033	4,677	*34·8*
1921–22	16,204	7,954	*49·1*	8,250	21,109	12,728	5,613	*70·6*
1922–23	19,759	9,762	*49·4*	9,997	22,043	12,594	6,322	*64·8*
1923–24	20,352	10,140	*49·8*	10,212	20,396	11,080	5,353	*52·8*
1924–25	25,637	13,628	*53·2*	12,009	23,309	13,270	5,917	*43·4*
1925–26	28,688	16,104	*56·1*	12,584	24,686	13,736	6,176	*38·4*
1926–27	29,215	17,977	*61·5*	11,238	26,139	15,777	6,880	*38·3*
1927–28	24,702	12,956	*52·4*	11,746	25,541	15,407	6,535	*50·4*
1928–29	27,229	14,478	*53·2*	12,751	25,872	15,066	6,778	*46·8*
1929–30	27,151	14,825	*54·6*	12,326	25,201	13,015	5,803	*39·1*
1930–31	26,705	13,932	*52·2*	12,773	22,481	10,901	5,084	*36·5*
1931–32	28,112	17,096	*60 8*	11,016	22,319	12,316	4,744	*27·8*
1932–33	24,031	12,727	*53·0*	11,304	—	—	—	—

The position has roughly been that America took what she wanted and the rest of the world could have the surplus. The result was that, when the American crop was small, the United States consumption percentage was high. At the same time the total production

* First compiled 1904-05, but very incomplete. In the early years the Federation statistics have been supplemented from other sources.

of Outside Growths was pretty steadily progressive compared with the fluctuations of the American crop, with the result that when the American crop was large it formed a high percentage of the world's total. Thus a high percentage consumption in the United States generally coincided with a low percentage of the American crop to the world's total, and conversely.

An examination of this diagram brings out very clearly the main



facts of the position. In the first place the percentage of the American crop to the world's total has been falling on the whole throughout the entire period, except for the bumper crops of 1911, 1920, 1926, and 1931, and even these peaks show the same declining tendency. On the other hand, the United States consumption percentage shows on the whole a steady rise until 1927-28. The next season showed a slight decline, but the great slump began in 1929-30 and has

continued ever since. Some of the details in the diagram are peculiarly interesting. Thus in 1915-17 America's consumption percentage was enormous because of the war demand which she was in a unique position to satisfy. The terrific peak of the United States consumption percentage in 1921-22 was due not only to the dramatic failure of the crop, but also to the fact that America recovered much more quickly from the post-war slump than any other country. Again in 1927-28 the United States percentage rose sharply, and this was due not only to the smaller crop but also to the fact that the American cotton industry was booming again. On the other hand, the fact that the United States percentage was the lowest on record in 1931-32 was due not only to the bumper crop but also to the fact that, owing to the depression, her consumption in that season was the lowest since the war, except for the slump year of 1920-21.

Looking back, then, over the whole period, there can be no doubt of the fact that the marked development of Outside Growths as a whole, in which the Empire has played a substantial part, was fully justified. But here the fact must be faced that what saved the world from a cotton famine at critical times during the whole period was not merely the development of Empire cotton but the development of Outside Growths all over the world. It is true that the rapid growth of the Indian crop contributed materially to the total of Outside Growths, but apart from that the contribution of the other Empire fields has been small in quantity though very important in quality. Thus the marked increase of the supplies of long-staple cotton in India, using the term in a relative sense, of course, as indicating cotton of $\frac{7}{8}$-inch staple and above, has enabled the Indian crop to compete substantially with the American crop, especially during recent years, when the quality of much of the American crop had deteriorated so seriously. A very important feature of that deterioration was the virtual disappearance first of the old long-staple Delta types from the Mississippi Valley, as the result of the boll weevil, and latterly the disappearance of the old Texas $1\frac{1}{8}$ inch staple cotton. In both these cases the gap has been very largely filled by Outside Growths. The Mississippi cotton was replaced by Egyptian Uppers and Peruvian and latterly, to a considerable extent, by East African cottons, which have maintained much more closely the old quality of their original progenitors, for the earliest success of the Uganda crop was achieved with cotton bred from the old Allen's long-staple upland, a Mississippi cotton. In the same way the loss of the Texas $1\frac{1}{8}$ inch cotton was the opportunity for the Peruvian American types such as Tanguis, as well as East African, and also

for the new Argentine supplies, and latterly for Russian cotton. Again, the situation created by the disappearance of the American Sea Island crop about 1918 was saved by the development of the Sakel crop in Egypt, and latterly in the Sudan, while for the small demand that remained for the very best Sea Island the British West Indies, of course, had no rival. Thus the general effect of the growth of Empire supplies has been to change very substantially the whole gradation of the world's cotton supplies, as pointed out in the writer's article on the classification of cotton in the issue of this Journal for January, 1932.*

Coming now to the events of the last three years, it is necessary to emphasize one point in which cotton differed from other commodities in regard to the sequence of cause and effect during the depression. In many commodities, such as wheat and rubber, it was alleged that the depression was due to excessive supplies, but that was certainly not true of cotton. On the contrary, the huge crop of 1926 had been quite comfortably digested in the two following seasons, and the Carryover at July 31, 1929, was only 4,332,000 bales. The whole trouble in the cotton trade was the restriction of consumption, and that began in America. At first it was due mainly to the decline of the internal cotton trade of the United States; but later on it was intensified by the unfortunate policy adopted by the United States Government in attempting to bolster up the price of cotton against the depression. The only effect of that policy was that the United States Government found themselves burdened with about three million bales of cotton at high prices, and that the world demand for cotton was to a substantial extent transferred from American to Outside Growths by the relatively high price of American. This process of substitution was intensified by the fact that the quality of the American crop was deteriorating.

It was not till the arrival of the huge and most unwelcome American crop of 1931 that the question of excessive supplies became the major factor in the fall of the price of American cotton. Even then, however, the trouble was still largely due to the restricted consumption of American cotton, and that restriction was most marked in America itself. As a matter of fact, in 1931-32 the situation was only saved by a remarkable increase of consumption of American cotton in the East. Owing to the failure of the Indian crop the price of Indian cotton was relatively very high, and China and Japan, following their usual custom in such cases, switched over very largely from Indian to American cotton. But for that the

* *Classification of the World's Cotton Crops*, Vol. IX., No. 1, p. 46.

Carryover of American cotton at the end of last season would have been even larger than it was.

It must be emphasized that these entirely abnormal conditions did not apply to other varieties of cotton to anything like the same extent. Even in Egypt, where the Government had adopted, though in a different form, the same unfortunate policy of buying up the crop, the position was not so bad, for they abandoned that policy at the earliest possible moment and took advantage of the consequent fall in the price of Egyptian, especially Uppers, to push the sale of their stocks in every possible direction, with the result that by the end of last season the statistical position in regard to Egyptian had become much more healthy, partly in consequence of heavy reduction of acreage and smaller crops. In the case of Indian the situation was entirely the reverse of the American, the recent small crops having resulted in an actual reduction of the Carryover last year. It will be seen therefore that American cotton has suffered most of all from the depression, and that the main cause of the unfavourable position of American cotton today is the restriction of consumption which began in America and has all along been most pronounced there.

But it is simply inconceivable that this strangulation of consumption has come to stay. Unless the world has permanently taken leave of its economic senses it would be sheer defeatism to believe that it will never recover from this depression. The causes are now known, though there may be differences of opinion as to the relative weight of different causes; the remedies are known, though the difficulties in the way of applying them may for the moment seem almost insuperable; but the present position is so intolerable that sooner or later the remedies must be applied and the world restored to something like normal conditions again. When that time comes the demand for cotton goods will certainly revive, for nothing has happened to change essentially the world's need for cotton goods of all kinds.

Before the war the world's consumption of cotton was increasing at the rate of about half a million bales per annum. During the first five years after the war the consumption, of course, fell off very badly, but in the next five years it made a handsome recovery. Thus, taking the figures from the Table on p. 84, the average consumption during the five seasons 1908-13 was 21,372,000 bales, from 1919-24 it was only 20,121,000, but in the period 1924-29 it rose to 25,109,000. The fall from these figures in the last two years to little more than twenty-two millions, or less than the two pre-war years, is entirely abnormal. Already there are signs of improvement in the current season, both in increased consumption of American cotton and a

very marked fall in the Carryover compared with last season; and if, as we all hope, 1933 is at last to see a rational settlement of world problems, the cotton trade should recover very quickly. World stocks of cotton goods are very low, and there is everywhere a great unfilled demand, for an impoverished world has been "doing without" for years, and would be only too glad to resume its purchases at anything like the present low level of prices if world conditions were improving. It must, of course, be remembered that if the recovery began say in the early summer after the year's crops have been planted, it would be nearly eighteen months before increased supplies could be grown and brought to market; but the present huge Carryover removes any danger of real scarcity during such an interval.

The only question remaining is whether, when normal conditions return, America will be any better able to supply the world's needs, and to keep on supplying the increasing need, than she was before the war, and a negative answer can be given to that question without any hesitation. There has been no change in the fundamental conditions ruling the American crop, except for the worse. A great deal of additional land has been brought under cotton cultivation in the extreme west since 1914, but the general conditions under which the crop is grown have not improved. America can still produce every now and then an almost miraculous bumper crop, but her average crop, tested by the yield per acre over five-yearly periods, is substantially lower than it was before the war; and the normal cost of production in the United States as a whole is probably higher than in any other major cotton-growing country in the world, especially if the cost of production be taken in relation to the quality of the cotton. Finally, the quality of the American crop as a whole is much lower than it was before the war.

Even during these terrible years of depression the total production of Outside Growths has held up remarkably well; in fact, but for an unfortunate succession of bad years in India, it would have shown very little reduction at all. There is no conceivable reason why, after having stood such a test, these countries should now give up the struggle and leave the world's cotton supplies again to the dominance of the American crop. Outside Growths now represent a really substantial and essential part of the world's supplies, and there is ample room not only for their return to the peak figures of 1928 and 1930, but for still further expansion. The world's crops in 1932 were substantially less than they were in 1914.

In the long struggle for the development of these Outside Growths

the Empire has taken its full share. The Indian crop plays a valuable part in preventing the price of American cotton going to extremes when the crop fails, because a large part of the consumption of the East can be switched over from American to Indian when relative prices make it worth while. It is very desirable that India should recover the ground she has lost since her record crop of 1925, and should carry on the improvement in the quality of her crop as a whole which has been so marked since the war. The recent completion of the Sukkur barrage should make it possible to advance still further both in quantity and quality. Again, within the range of the Outside Growths themselves Empire cottons play an important part by providing alternative supplies and checking the tendency for any particular variety to go to extremes when supplies happen to be reduced—*e.g.*, Sudan Sakel against Egyptian, and East African against Peruvian.

It is therefore essential that those who have been responsible for the development of Empire cotton-growing in the past should be encouraged and assisted in every possible way to pull through these hard times and to maintain their organization, so that when normal times come again they may be ready to carry on and extend the work still further. All the expenditure in time and money, especially in providing means of transport to the fields that are far from the seaboard, will be still more fully justified in the future than they have already been in the past.

Received January, 1933.

COTTON DISEASES

BY

E. J. BUTLER, D.Sc., F.R.S.,
Director Imperial Mycological Institute.

COTTON resembles wheat in the difficulty it presents of assessing the losses in yield caused by cryptogamic and virus diseases, but while methods have been devised for determining the damage done by most of the major wheat diseases, nothing of the kind is available, so far as the writer knows, for cotton. A few of the diseases mentioned below, Texas root rot and some types of *Fusarium* wilt, for instance, present no great difficulty, for they kill groups of plants and leave bare patches of greater or lesser extent in the field. When *Fusarium* wilt is sporadic, however, so that only single plants wilt in a scattered fashion throughout the field, the amount of loss of crop depends on the age at which the plants die and the habit of the variety grown. In this type of wilt in parts of Khandesh in India, the writer concluded that there was little loss when the plants wilted before they were half grown unless the incidence of the disease exceeded about 10 per cent. of the stand. Khandesh cotton branches freely, and the gaps left by the death of young plants were largely filled up by the surrounding ones. Had a cotton of the Sakel habit been grown, this would not have occurred, as this type does not form sufficiently extensive laterals to fill up bare spaces. In the neighbouring area of the Berars, *jari* cotton is killed by wilt in large patches which are left quite bare, and the loss may be heavy and is easily estimated. With other diseases it is often exceedingly difficult to assess the damage, either because other causes may be concerned in addition to the disease (climate or soil factors, for instance), and the extent to which they are responsible for increasing the loss of crop may not be calculable, or because the disease does not kill but merely weakens, and a method of determining the effect of this on the total crop has not yet been evolved. Examples of the former are found in blackarm and of the latter in most of the leaf diseases of the crop.

It will be understood, therefore, that the estimates that have been framed of losses from disease in the cotton crop allow of a considerable margin of error. The most elaborate are those of the United States Department of Agriculture as given in Supplement 83 of the *Plant*

Disease Reporter, 1932. They cover the three years 1928, 1929, and 1930, but are incomplete, for several States in the cotton belt furnished no returns. For those that did report, comprising about three-quarters of the cotton belt, the total loss from diseases (other than injuries caused by insects, worms, etc.) is given as about 16 per cent. of the crop. This represented an average loss of over 1,600,000 bales of cotton annually from three-quarters of the cotton belt during the three seasons in question, or assuming that the non-reporting States had equal losses, disease reduced the United States cotton crop annually during these years by well over 2,000,000 bales. Individual State estimates may indicate losses even greater than this, Florida estimating in 1930 that the average annual loss was somewhere between 15 and 25 per cent., Texas counting its loss from a single disease, the root rot, at 10 to 15 per cent., and Arizona calculating that the same disease costs the farmers in the State (not a large cotton grower) up to $5,000,000 in some years.

In the Russian province of Azerbaijan, bordering the Caspian Sea, Jaczewski states that in 1927 wilt reduced the yield by 9·1 per cent. In Russian Turkestan, Zaprometoff in 1929 estimated that some 150,000 acres of cotton are infected by wilt which reduces the crop by 27 per cent. Fahmy made some estimates of the prevalence of the same disease in some villages in Lower Egypt in 1924, and cites a case, not, he says, an uncommon one, where 25 per cent. of the Sakel plants on an area of 644 feddans (out of 696 feddans of Sakel grown by the village) had wilted, estimating the loss of crop at about one-sixth. In 1927 he reported that wilt had become so severe in some of the best cotton lands of the Delta that many cultivators had abandoned the susceptible Sakel for hardier (wilt-resistant) short staple varieties. In 1930 he estimated that the loss due to wilt in the Sakel crop of Lower Egypt varied between 5 and 15 per cent. annually.

The third in importance, after root rot and wilt, of the major diseases of cotton is probably the bacterial disease due to *Bacterium malvacearum*, which causes blackarm, angular leaf spot, and bacterial boll rot. In 1927 it was estimated to have caused a reduction in yield in the United States of approximately 500,000 bales, and in the West Indies it is said to destroy from 2 to 20 per cent. of the crop. In the Sudan the losses in certain years in the Sakel crop have been undoubtedly higher than those recorded elsewhere, but it is probable that few would be prepared to attempt an accurate estimate of them.

Anthracnose and sore-shin are two diseases that must be included as major affections, for in certain places and under certain conditions

they can cause great injury to cotton. Anthracnose was stated in 1930 to cause an annual loss in the southern States of about 150,000 bales on an average, but to vary greatly from year to year. Losses of 90 per cent. of the bolls from this cause have been recorded from some of the Florida cotton fields, and in 1923 it caused an estimated loss of 36,000 bales in North Carolina. Sore-shin is well known as the cause of much trouble in Egypt when sowing is done under certain weather conditions, and is stated to be the most common cause of poor cotton stands in Florida. Severely affected fields are usually resown, and hence it is impossible to assign figures to the losses caused by this disease, but it is always a serious problem in places where the cotton is liable to be sown in cold soils. In warm soil conditions it is incapable of causing injury.

Another disease of considerable importance, but for which it is difficult to give figures, is the internal boll disease, due to several allied yeast-like fungi that are conveyed into the bolls by cotton stainers (*Dysdercus*) and the green bug (*Nezara viridula*). Sea Island cotton in St. Vincent and Montserrat frequently lost most of the late bolls from this cause before control measures were taken in hand. In Wagale cotton an incidence of 7·5 to 17 per cent. has been reported from Burma and one of 24 per cent. in Cambodia cotton.

A disease, the full potentialities of which are not yet known, but which may come to be considered one of the major diseases to which the cotton plant is liable, is the virus disease known as leaf curl, which has hitherto been found only in Nigeria and the Sudan. Its restricted incidence, however, keeps it from being ranked as a major cotton disease at the present time, and there are no reliable estimates of losses from it known to the writer.

Minor diseases of the leaves and bolls are numerous, and almost any of them can at times and under certain conditions cause a good deal of injury. Most of these, though in the aggregate they must cause an appreciable loss of cotton, are seldom considered of sufficient importance to justify attempts to estimate the injury they do.

Of the major diseases mentioned above, the Texas root rot is the most remarkable in many ways. It is confined to the south-western part of the cotton belt and is not known anywhere else except for reports from Russian Central Asia. It is caused by a soil fungus, *Phymatotrichum omnivorum*, a natural denizen of the virgin soils of this region and one which is capable of attacking the roots of a very large number of plants, from lucerne to fruit trees and wild bushes: about 550 of these host plants have been recorded. The total annual

money loss caused by this fungus on all crops in Texas was put at the almost fabulous figure of $100,000,000 in 1931, and at the Fourth Annual Conference, held in that year, of the workers engaged on this disease jointly by the Federal and Texas authorities, eighteen of the members present were giving their whole time to its study and another sixteen were part-time workers on it.

The fungus spreads like a fairy ring through the soil, killing the plants at the margin of spread each season, but tending to die out in the centre of the circle. On the surface of the soil or the side walls of trenches, etc., it forms spore-bearing mats, but most of its life is passed underground, and it is well equipped by the possession of resting sterile stages (sclerotia) and mycelial strands to dispense with the ordinary means of spread by air-borne spores. Indeed, inoculations with the spores have not been successful and they are not known to play any part in disseminating the disease. It is most prevalent on alkaline soils and has not been found on those of a definitely acid reaction, being rather in contrast to wilt in this behaviour. It passes the winter on old cotton roots or on various wild plants and weeds, a wild convolvulus, *Ipomœa trichocarpa*, being one of the worst offenders in this respect.

Rotation, with such an omnivorous feeder, is not much use unless bare fallows can be maintained or non-susceptible crops (*e.g.*, cereals) be grown and kept clean weeded for several years. Trenches and other barriers to check the steady advance through the soil are effective if made to a depth of two to four feet, but are naturally expensive. It has been found that sorghum acts as a barrier to spread, and belts of four to twelve rows of grain sorghum kept free from weeds have proved valuable in saving uninfected fields from spread underground from adjacent infected ones. Finally, attempts have been made to find strains of cotton resistant to root rot so that they might be used for breeding or selection of suitable resistant stocks, but so far without much success. Altogether the root rot is a most formidable problem.

Cotton wilt is one of a large group of plant diseases characterized by invasion of the water-carrying vessels of the root and stem by a parasitic fungus. Until recently it was believed that only a single species of parasite was concerned, *Fusarium vasinfectum*, but it is now known that several other species of *Fusarium* can attack cotton roots in Egypt and the Caucasus, and that a very similar disease is caused by quite another kind of fungus, *Verticillium albo-atrum*, in the United States, South Africa, Central Asia, and Bulgaria. All these fungi produce similar symptoms, and the term "wilt" may apply to all. They are soil organisms and extremely persistent, so

that it is difficult to exterminate them once the soil becomes infected.

Penetration into the plant occurs through the fine roots, but once the fungus reaches the water-conveying vessels it spreads along these and may extend up the stem to a considerable height. The wilting is due partly to the blocking of the vessels and partly to a toxic action of excretions from the fungus. The leaves turn mottled or yellow, droop, and die, and the plant dries up. On the stems, especially towards the base, the fungus comes to the surface as the plant dies and produces pinkish masses of spores which disseminate the disease. Spread also occurs through the soil so that spreading patches, in which at times all the plants are killed, result.

Control is by prolonged rotation and the growing of resistant varieties. Fortunately a number of these latter are known, and wilt-resisters have now been developed that are suitable for most conditions. These are in wide use for wilt-infested lands in the United States, and both in Egypt and in India several resistant types have been selected and are now being pushed. As is usually the case, it has been found that each country must produce its own wilt-resisters. Fortunately, true immunes appear to occur in several of the main cotton types—*e.g.*, the Ashmounis in Egypt, Buri (*Gossypium hirsutum* var.) in India, and the Bokhara var. of *G. herbaceum* in Russia (against the wilt prevalent in Azerbaijan due to *F. caucasicum*). True immunity does not seem to have been encountered in American Upland cottons in the United States, but a number of varieties, such as Dixie and its derivatives, Miller, Willis, Cleveland 54, etc., are commercially resistant or tolerant and give good crops in wilt-infested land.

There is no need to refer other than very briefly to the bacterial disease, in view of the series of papers by Massey, Hewison, and others in this REVIEW on the outbreaks of blackarm in the Sudan during recent years. The organism occurs in most cotton-growing countries, but is only severe in the Sudan, some parts of the United States, the West Indies, Nigeria, Guatemala, South-Eastern Russia, and Korea. The long staple Egyptian and Sea Island varieties are the most susceptible to its attacks, and this is one of the principal reasons why Egyptian cotton has not been profitably grown in the south-eastern parts of the United States. Nevertheless, cotton in Egypt itself does not suffer appreciably from *B. malvacearum*, though the organism is common there and the same cotton, Sakel, as in the Sudan, is widely cultivated. This fact shows its close dependence on its environment as a source of harm. High temperature and high humidity have been

proved by work both in the Sudan and at Rothamsted to be most suitable for successful infection, but exceptions have been reported, such as a dry weather outbreak of blackarm and boll rot, with little or no leaf spotting, in Barbados in January, 1918.

Seed treatment is the most effective direct method of control, as the organism is freely carried over from one crop to the next on the seed. Soil infection is considered in the United States to be infrequent because the organism does not remain long alive in the soil, but the experience in the Sudan suggests that infection frequently comes from the soil (dust, etc.) from the previous year's fields, so that adequate crop rotation and distance from the fields that bore the previous crop may be important. Resistance is known to occur in certain strains, all the pedigree strains of Sea Island now grown in St. Vincent showing considerable resistance to the disease.

Anthracnose, caused by the conidial (*Colletotrichum gossypii*) stage of *Glomerella gossypii*, used to be considered the most serious cotton disease in the United States before root rot and wilt became prominent. The fungus does little or no harm to the growing plant though it sometimes causes damping off of the seedlings, but it attacks the bolls through the flowers, or more usually on the side walls, causing sunken spots that often penetrate to the lint and seeds and that become covered with pinkish spore masses. The effect is to dry up or distort the bolls and ruin the lint, sometimes only in one or two of the locks. The organism is very widely distributed in the New World; India and the Sudan appear to be mostly too dry for it, but it occurs in Burma and is prevalent throughout most of West and West-Central Africa. Anthracnose frequently follows bacterial boll rot and may obscure the latter.

As the disease is transmitted on the seed, the use of clean seed is usually sufficient for control. It has been found not to survive on the seed for much more than a year, so that two-year-old seed is usually quite safe. Machines for the hot-air treatment of cotton seed against this disease have been devised in America, but with reasonable rotation and two-year-old seed their use is not necessary.

Sore-shin due to *Rhizoctonia* (*Corticium*) *solani* occurs everywhere, this fungus being a regular inhabitant of most soils in all countries. In classical studies carried out in Egypt many years ago, Balls showed that it can only cause injury to the young cotton when sown in cool soils and kept cool during the very young seedling stage. In this its behaviour is the reverse of blackarm, and the relative prevalence of the two diseases in Egypt (sore-shin common, blackarm rare) and the Sudan (the reverse) reflects this difference in their temperature

preferences. Early sowing to avoid boll weevil injury in the States has been considerably hampered by increased tendency to sore-shin. Seed treatment with dusts such as Abavit and various other mercury-containing fungicides has reduced damping-off due to this and other fungi, but the best method where possible is the avoidance of sowing in cold, damp soils.

Besides the killing of seedlings due to this fungus various other types of damping-off occur in the seedling crop. A frequent form in India (known also in Uganda, Nigeria, Trinidad, and Egypt) is due to *Macrophomina phaseoli*, another common soil fungus, but one apparently confined to warm countries. Its attacks cause the seedlings to dry up while still erect, and are more sporadic than those of the true sore-shin fungus, though a mortality of 30 per cent. has been seen at times in the Central Provinces of India; no way of avoiding them is known. *Gibberella moniliformis* causes a root rot of seedlings in the southern States (especially Georgia) and in Turkey, and has also been found in Tanganyika, Uganda, Queensland and elsewhere injuring the bolls, usually such as have been punctured by insects. Species of *Phytophthora* and *Pythium* have also been reported to cause damping-off in India, and *Sclerotium rolfsii* in the West Indies, India, Ceylon, Porto Rico, and Texas, the latter being particularly troublesome in wet weather on Sea Island cotton in St. Vincent.

The internal boll disease is one of the most remarkable of fungal diseases, being the first that was studied of a widespread type of fruit diseases due to a curious group of fungi that are introduced into the interior of the fruit by sucking insects. They have been given the special name of Stigmatomycoses. The stigmatomycosis of cotton is due to one or other of five of these fungi, *Nematospora gossypii*, *N. coryli*, *N. nagpuri*, *Spermophthora gossypii*, and *Eremothecium cymbalariæ*, of which the first two are the most widely distributed, being found in the West Indies, South Africa, most of tropical Africa (the Gezira tract in the Sudan being an exception), Russian Central Asia, and Burma. *N. nagpuri* has so far only been found in India, and *S. gossypii* and *E. cymbalariæ* in the West Indies. As, however, their presence is often masked by secondary followers, their distribution is probably much wider than reported hitherto. *N. coryli*, for instance, has recently (1928) been found on cotton in California, and is quite likely to occur on this host also in the eastern States.

All these fungi have minute needle-shaped spores with, in addition, round or oval yeast-like cells. These spores are introduced into the interior of the bolls in the sucking apparatus of the *Dysdercus* or

Nezara, and no sign of their presence is visible until the boll opens, when the lint is found stained and rotted and the seed often shrivelled. The fungi are active fermenters and appear to be able to penetrate through young cell walls and unthickened lint fibres. In the seed, penetration into the embryo has been observed, but the exact relation of the fungi to the host cells appears to be still obscure. It is believed that the insects pick up the fungus from other host plants in the neighbourhood of the cotton fields, and in South Africa the tree *Sterculia platanifolia* was implicated in a subsequent outbreak on the cotton fields. In Uganda, where this is regarded as the most serious cotton disease, it has been shown that the fungi cannot be transmitted by young *Dysdercus* nymphs, nor grow through the boll wall even if wounded. In the West Indies and Nigeria they are held to be responsible for considerable boll shedding, and in East and South Africa and Burma this must rank as a major disease of the crop.

Excellent results were obtained in St. Vincent by the eradication of the alternate food plants of *Dysdercus* that are utilized by the insect early in the season. This so delays the appearance of the stainers that a clean crop may be harvested. It is probable that this is the most hopeful line of attack on a disease that is exceptionally difficult to control.

Leaf curl was first seen in Nigeria but did not attract much notice until its appearance in epidemic form in the Sudan in the last few years. Space does not permit of an account of this disease, which has been fully described in several recent publications. It differs from all the others mentioned in being due to an invisible agent or virus, but resembles the internal boll disease in being insect-transmitted, the vector being the whitefly, *Bemisia gossypiperda*. Control will ultimately come from the growing of resistant varieties, several of which have already been found amongst the long and short staple cottons available locally, but until one suited to the special conditions of the Gezira is developed, every effort is being made to prevent the disease from being carried over the period between successive crops by eradicating self-sown and ratoon cotton after harvesting.

Some of the minor diseases of cotton can cause considerable injury in certain conditions. There is, for instance, a soft rot of the bolls in St. Vincent, Montserrat, and Porto Rico due to *Phytophthora palmivora* and *P. parasitica*, which destroyed over 60 per cent. of the bolls in July plantings in St. Vincent in 1927, but which can be largely avoided by late planting (after September 1). The boll disease due to *Diplodia gossypina* is said to render 50 per cent. of the bolls worthless in many fields in Florida and to have cost the State as a whole

about 20 per cent. of the crop in the wet season of 1928. Evidence has been brought forward in the United States to show that this fungus is an imperfect stage of *Physalospora rhodina*, and, if so, it belongs to one of the most widely distributed tropical weakly parasitic fungi. But like various other boll rots attributed to common moulds such as *Rhizopus nigricans* and other species of this genus, *Aspergillus niger*, *Alternaria*, *Fusarium*, *Cephalosporium*, *Epicoccum purpurascens*, and *Nigrospora oryzæ*, these are so likely to follow and obscure more primary boll-rotting organisms that much caution is required in considering them as the real cause of injury. This does not apply, however, to two species of *Alternaria*, *A. macrospora* and *A. gossypina*, which cause leaf spots and boll rots in Nigeria, Southern Rhodesia, Uganda, Tanganyika, and Trinidad. This disease can cause heavy defoliation and boll shedding in wet weather in Nigeria, and the fungi have been proved experimentally to be true parasites of cotton.

Of the large number of minor leaf parasites there are a few that seem to have dangerous possibilities, such as the mildew *Erysiphe malachræ* common in the West Indies and Peru, the rust *Cerotelium desmium* found almost throughout the cotton-growing countries, the leaf spots due to *Ascochyta gossypii* and *Mycosphærella gossypina*, and the areolate mildew *M. areolæ*. All these true parasites occur chiefly on mature leaves or too late in the season to do much harm, but serious injury has been recorded somewhere from all of them, and any may one day become important. Phytopathological history is full of records of parasites long regarded as harmless but that have proved to be the limiting factor in the introduction of some new improved variety or in the extension of the crop into some new region.

Received February, 1933.

SOME NOTES ON MOCO COTTON IN BRAZIL

BY

S. C. HARLAND, D.Sc. (Lond.).

THE main cotton-growing industries of the world, so far as New World cottons are concerned, are based upon the two species of cultivated cotton, *G. hirsutum* (Upland) and *G. barbadense* (Egyptian, Sea Island, Ishan, Kidney, etc.). It is not sufficiently appreciated that there exists a third species of cultivated cotton, which though closely allied to Upland differs from it not only genetically, but possesses a great range of physiological adaptation to diverse climatic conditions. More than 100 years ago there was a flourishing cotton industry in the West Indies based mainly on this species, and the cotton was then known by the name of Bourbon. Botanically the Bourbon group may be assigned to the species *G. purpurascens*, Poir. The species varies considerably in morphological characteristics, and includes a number of sub-groups, some of them truly wild, such as the wild types of certain West Indian Islands (*e.g.*, Patos). The Polynesian species *G. taitense*, Parl. (Fiji wild), may be considered as a sub-species of the Bourbon cotton, since it hybridizes with it with little or no sterility, and shows simple Mendelian inheritance of several characters.

In view of the great importance of Bourbon cotton from a plant-breeding point of view the writer welcomed the opportunity in June, 1930, to examine the conditions in the Serido district of Rio Grande do Norte (Brazil). In this district there exists a flourishing cotton-growing industry based on a perennial cotton of Bourbon type known as Moco, which possesses the longest and finest staple in the whole of Brazil.

COTTON ZONES IN THE STATE.

The State lies about 6° to 8° south of the Equator, and is roughly divided into two main bio-climatic zones:

(*a*) A littoral belt of moderate rainfall (30 or more inches).

(*b*) An Upland region of about 1,000 feet elevation, extremely dry, with usually 18 inches or less rainfall during the cotton-growing season.

The littoral belt grows a cotton called the "Verdao," or green seed cotton, which is a collection of dilute hybrids of the Moco tree cotton by various introduced strains of American Upland. The Upland, or Sertão district, grows mostly the perennial Moco cotton, though in some places the Verdao cotton is preferred. Both cottons have much interest in relation to tropical African conditions.

Two days were spent inspecting the cotton plots at the Experiment Station devoted to Moco cotton near Acary. Here there was a very interesting selection of Moco cottons which were at once seen to belong to the great group of Bourbon cottons, *G. purpurascens*, Poir, a species principally characterized by a smooth boll, late bursting anthers, and a perennial habit which renders it capable of being ratooned successfully for several years. The lint is usually from 34 to 40 mm. long and is extremely fine in quality. Its fineness may be judged by the fact that it has been spun into 136's yarn.

1. Climatic Conditions.—The intense aridity of the climate was very striking. The whole Moco district is ecologically of the cactus-acacia association type, very similar to much of the arid sections of South Africa. It is strongly brought home to the botanist that cotton is essentially a dry climate plant. Here, with about 18 inches of rainfall annually, cotton looks really happy. There was a pronounced air of health and vigour about the plants, and it was felt that here indeed cotton had climatic conditions and soil which thoroughly suited it.

2. Insect Pests.—(*a*) There is no cotton stainer and no internal boll disease.

It is curious to find no stainers, since in Peru the species *Dysdercus ruficollis* often inflicts great damage, while the same species is recorded in São Paulo, also in Surinam, where it is alleged to render impossible the growing of Sea Island cotton. The absence of internal boll disease may be understood, since we have evidence from as widely separated tracts as Upper Burma, Southern Transvaal, and the Virgin Islands that if environmental aridity is pretty high the damage from internal boll disease may be absent or negligible. It is only in more humid districts that the disease begins to assume prominence. The absence of the stainer itself is puzzling, and no explanation can be suggested. It is not due to absence of available food plants, since both the Upland and littoral districts are characterized by abundant species of *Malvaceæ*, which in other countries serve as hosts of the stainer. One can maintain that from an entomological point of view the absence of an insect is of equal importance to its presence, and it

would be of great value to ascertain the limits of distribution of the stainer in South America and the reasons for its absence in particular localities, such as the one under discussion. Enquiries about the status of the stainer in the State of Ceara (north of Rio Grande) were made, and the information was given that it was also unknown in that State. No information is available as to whether the stainer exists in the States of Para or Amazonas, but it is clear that somewhere between Dutch Guiana and Ceara the stainer vanishes, and that it reappears somewhere between Rio Grande and São Paulo.

The complete absence of internal boll disease in a tropical country is enormously important, and gives this section of Brazil a great advantage over those countries in Africa where this disease is so prevalent and destructive.

(*b*) There are no bollworms (Heliothis).

Here again the contrast with South Africa is great, since Heliothis, though present in both the West Indies and Brazil, is not known to be a pest of cotton in either country.

(*c*) The pink bollworm inflicts damage in direct proportion to the aridity of the climate.

In the Upland district the damage is said to run in the neighbourhood of 10 per cent., but this estimate is possibly rather high. In the littoral the damage increases with the rainfall, and is much greater. In spite of this, however, it does not seem to be anything like so troublesome as stainers or bollworms in Africa. Owing to adequate fumigation methods, very little infested seed is planted, and all farmers are familiar with control methods (such as exposing the seed to the heat of the sun), which deal with the resting larvæ in the seed.

(*d*) The severity of cotton worm attack in certain seasons.

The cotton worm (*Alubama argillacea*) is the only pest of real importance in the State. Invasions come from the South, and there is often complete defoliation of the plants in a number of attacks. This pest can be controlled easily by arsenical dusts and sprays, but the large size of the plants renders this method of control very difficult and not always practicable for the small farmer. Spraying from mule back would appear to be a practicable method.

If several heavy attacks are experienced in a period of deficient rainfall, the defoliated plants are unable to recover, and the crop may be almost a total failure, as was the case in 1928. There seems to be some sort of correlation between a heavy attack of cotton worm and a light attack of pink bollworm and *vice versa*. This may be ascribed to the creation of a " parasite reservoir " by means of which

the parasites common to the cotton worm and the pink bollworm are enabled to control one or the other. The interrelation between the parasites of one species and those of another has so far received little attention.

(*e*) The existence in very small numbers of pests which in other countries do a lot of damage.

Jassids are present, but are not a pest. This situation is similar to that in Trinidad where jassids are only a pest in the greenhouse.

The following other insects were recorded:

(1) *Corythuca gossypii*. This occasionally inflicts damage on young plants. As in the West Indies, it attacks the castor oil plant (*Ricinus communis*) as an alternative host.

(2) *Aleyrodes* sp. (*white fly*). This is present in small numbers, but inflicts no damage. It is probably heavily parasitized.

In Nigeria this insect, or a related one, is considered to be the vector of leaf curl disease.

(3) *Aphis* sp. This attacks young plants sporadically, but the writer has never noticed that it attacks old plants to any extent.

(4) *Oxycarenus hyalinipennis*. This bug, or a related species, is common in South Africa. It was probably introduced into Brazil from Egypt by means of seed at the same time as the pink bollworm. It feeds on a large number of alternative hosts, but is more of a nuisance than a pest owing to its habit of clustering in larger numbers in the newly opened bolls. The germination of seed is probably injured to some extent.

(5) *Scale insects*. White Scale (*Chionaspis* sp.) was seen, and also a species of Black Scale closely similar to the Black Scale (*Saissetia*) of the West Indies. The White Scale was rare, although in the West Indies it is capable of becoming a serious pest of perennial cotton. Black Scale is a serious pest of annual cotton in Barbados and sometimes is so in Trinidad. It is disseminated in the West Indies by the ubiquitous black stinging ant, but this ant was not seen in North Brazil. If it exists, it must do so in small numbers. Here again the conditions of North Brazil do not favour the development of scale insects on cotton in the Upland areas. The status of scale insects in the littoral was not gone into in detail.

3. The Absence of Fungoid Diseases.—The absence of the major tropical disease—internal boll disease—has already been stressed, but there is also almost complete absence of Black Arm and Angular Spot (*B. malvacearum*) in the Upland tract. The environmental conditions are not favourable to the existence of this disease. In the Upland district Angular Spot was recorded only once, and that was

in a river valley where conditions were humid. Here there was a good supply of underground water, and the plants had put on excessive vegetative growth. Typical Angular Spot lesions were seen on the leaves, though both the Black Arm phase and the external boll-rot phase were absent.

It must be pointed out that a plot of Moco cotton from this district was grown in St. Vincent in 1915. The plants experienced an acute attack of Black Arm, and more than 50 per cent. of the plants succumbed during the seedling stage.

Two distinct lines were isolated, one moderately attacked and the other severely attacked. This observation supports the view previously expressed—namely, that if a cotton is transferred from an arid district into an area of relatively great humidity, an attack of Black Arm is sure to result. This has always been the case when Egyptian cotton has been taken to a rain belt; it is the case with Moco. The idea should rather be to build up resistance to Black Arm in a country decidedly more humid than the one in which it is intended to grow cotton.

Boll diseases due to *Phytophthora*, *Diplodia*, *Phoma*, etc., characteristic of more humid climates, were absent, nor was there any record of the Fusarium wilt disease. Altogether North Brazil is an exceptionally favoured tract from the pathological standpoint.

Selection Work with Moco Cotton.

The Moco Experiment Station exists for the purpose of isolating pure lines of Moco cotton for dissemination among the farmers. So far it seems that little progress has been made as the cultures alleged to be from self-fertilized parents were found to be extremely mixed. Potentially the Moco cotton may be regarded as one of the most valuable cottons in existence. It is thoroughly adapted to arid tropical conditions, and there are possibly large areas in the British Empire which would suit Moco. Moco at its best is considerably better than the best Sakel Egyptian. The lint length of several thousand plants was examined, and about fifty selections were ultimately made of the best types in the State. Five of these were examined intensively in Trinidad, and have since been studied in St. Vincent with the object of replacing the present impure Marie Galante type by Moco. This should lead to good results in the Grenadines, and possibly a perennial cotton industry based on Moco may ultimately extend to the Virgin Islands and possibly also Nevis.

Now although Moco at its best lies somewhere between the longest

Egyptian and the shortest Sea Island, it is so badly contaminated in Rio Grande that the present condition of the cotton by no means represents its full value from a plant-breeding point of view. There are many undesirable types in field crop. The lint length may be as high as 46 mm. (the best selection), or be as low as 20 mm.

The Moco industry succeeded an industry based on a rather short staple Kidney cotton (*G. Brasiliense*). The original Moco type was undoubtedly a true wild type now represented by a few khaki-linted plants of the " Macaque " (monkey) cotton growing sporadically in the mountains. Some of this cotton was seen. It was of quite good quality and very productive when taken into cultivation. It is not unreasonable to assume that during the transition period, when Moco was replacing Kidney, a certain amount of natural crossing took place. The first cross is extremely productive, and such hybrid plants would no doubt be selected for seed purposes. The result is that practically every field examined was contaminated by Kidney, and could virtually be described as a Kidney-Moco hybrid swarm. The cross Kidney-Moco is an interspecific hybrid, and subsequent generations of such a cross invariably result in plants which are often almost completely sterile, or which shed a great deal, or which show undesirable features such as fuzzy seeds or very short lint.

Familiarity with the genetics of similar crosses in Trinidad enabled plants of Kidney ancestry to be picked out. It has been noticed, for example, that the F_1 of Peruvian-Bourbon crosses often, though not always, has a characteristic shortening of the internodes, with leaves rather crumpled, and often with chlorophyll-deficient patches along the veins. Such types are in the West Indies called " loggerhead " cottons. Where this loggerhead type is seen it provides a clear indication of Kidney ancestry. Other undoubted signs of contamination by Kidney are (*a*) Kidney seeds, present rather rarely; (*b*) a dark green leaf, contrasted with the typical lighter green Bourbon leaf; (*c*) petal spot weak or missing; (*d*) a big heavy seed, not found at all in typical Bourbon, though characteristic of hybrids; (*e*) early bursting anthers—Bourbon has late bursting anthers.

The difficulties in the way of obtaining pure Moco are thus rather great, and can only be overcome by the use of genetic knowledge obtained by a study of artificially produced hybrids. As was said above, we are fortunately now in possession of the necessary knowledge.

The Verdao Cotton.

The fact may be recapitulated that the perennial Moco is grown in the Upland region—arid and about 1,000 feet above sea-level, with rainfall typically from 12 to 18 inches during the growing season. The lands under cotton are normally characterized by a vegetation composed chiefly of cactus and acacia scrub, and the soils are chiefly decomposed granites and granitic schists—not unlike those of the Mtoko district of Southern Rhodesia. The littoral belt has evolved an entirely different cotton, and presents problems which affect us largely in seeking a type of cotton suitable for tropical latitudes with a rainfall of 30 to 40 inches.

The Brazilian cotton grower has solved the problem by methods all his own. Upland cottons were introduced, and these were subjected to a severe process of natural selection. They crossed extensively with Moco, and the resulting hybrids were extremely productive. This has been found also to be the case in artificially made Upland-Moco hybrids in Trinidad. Such plants would possess many of the acclimatization factors of Moco, and the very fact that more cotton would tend to be picked from the hybrids than from pure Upland has gradually produced an acclimatized type intermediate between Moco and Upland. The lint is rather better than Upland, and the seed is fuzzy and green. The fuzz comes from Upland, and the green colour of the fuzz from Moco. This welter of dilute Moco-Upland is known as "Verdao," and now constitutes the major part of the cotton produced in the State. The view has been expressed elsewhere that a cotton-growing industry based on a sub-tropically acclimatized cotton such as the modern type of Upland is not likely to be successful in the tropics until the necessary acclimatization factors have been accumulated. This can be done in two ways: (*a*) By selection in commercial Uplands—a slow and often unsuccessful business, since the Uplands introduced may not have the necessary factors at all; and (*b*) by crossing with an already acclimatized indigenous form and allowing natural selection to come into play in the offspring. It is the latter process which has been carried out in N. Brazil, without the intervention of scientific work at all. In spite of the fact that the Verdao cotton is about as mixed as an F_2 of the original cross, it is extremely successful as a commercial cotton, and the spinner will pay a price above ordinary Upland for the lint. Evidently purity of strain may not be so important in short staple cottons as has been imagined.

Efforts are being made by the Cotton Service of the State to purify the Verdao type, but it is quite excellent even as it stands, and is worthy of trial in many parts of the Empire.

APPENDIX.

EXPORTATION OF COTTON, STATE OF RIO GRANDE DO NORTE.

	Kilos.		*Kilos.*
1901	1,557,374	1915	5,460,624
1902	2,291,135	1916	4,350,489
1903	3,167,359	1917	8,674,848
1904	1,554,871	1918	9,137,714
1905	3,710,446	1919	5,367,093
1906	4,367,581	1920	5,283,017
1907	5,024,716	1921	10,568,805
1908	3,628,632	1922	12,367,811
1909	689,884	1923	9,434,323
1910	10,866,114	1924	6,890,450
1911	14,137,682	1925	9,924,815
1912	12,226,807	1926	11,246,561
1913	9,711,107	1927	12,664,265
1914	5,381,266	1928	16.000,000

Received February, 1933.

PURITY AND VARIABILITY IN COTTON

BY

C. H. BROWN.

In a previous article (*E.C.G.R.* ix., 1932, p. 119) the technique now in use at Giza for the testing of comparative purity of strains was described. It was stated then that differences were disclosed by this technique which were not obvious by any other means. Recent work has only emphasized the truth of this, and so many examples now exist that some further observations on the subject seem appropriate. The writer has been particularly struck recently, not only by the amount of impurity that can exist in "apparently pure" strains, but also by the extent of the different physiological reactions to climate and soil which can exist in strains with very small morphological differences.

These points are of such great importance in cotton breeding work that no excuse need be given for elaborating them. There is no reason to doubt that on close examination it would be found that the experience with Egyptian cotton in Egypt is paralleled by any cotton group in any part of the world.

The great practical interest of the whole question is the extent of the differences found in related strains of single plant origin, the whole of the strains of one variety origin being easily covered by the general name "variety." There is no reason to suppose that Sakellarides and Ashmouni as bulk varieties are any more impure than similar well-known varieties grown in bulk in all cotton-growing countries—rather perhaps the contrary. But several of the varieties now being examined are recent single plant selections from the older varieties, and still they seem to show almost unlimited possibilities for variation. Take first the case of Giza 7. This was a single plant selection in 1922 from an Ashmouni field. Ashmouni fields were then less pure than they are now, and such field selections of a radically different type could hardly now be repeated. The genetic origin of Giza 7 is unknown. It is quite easily distinguishable, not only from Ashmouni but from any other variety known in Egypt then or since. We must suppose it was the result of a natural cross, with presumably Ashmouni as one parent; Sakel, Sea-Island, Casuli, or Yoannovitch might conceivably have been the other parent. However that may

be, the plant destined to become Giza 7 gave "apparently pure" progeny from the first year's trial, and in fact the recorded description of the lint of the original selected plant exactly describes the variety type today as far as general description goes. The strain was selfed for four years in the pedigree lint plot before it was propagated in bulk, and the selfed single plants compared to make sure they were equivalent for a nucleolus stock. Immediately differences became apparent. The present selected nucleus stock, from a single plant in 1927, gives distinctly lower hair-weights and better lea strength than the bulk, while being apparently identical vegetatively. Since the original selected plant had all the general appearance, when grown on, of vegetative purity—which suggests that it was the F_8 generation, at the very least, of the cross that produced it—the point of interest is that, although it has settled down to vegetative purity for characters which have been used as criteria for several years, it is still continuing to segregate for lint characters, which we have only recently been able to use as additional criteria.

Sakha 4 has lately shown signs of exactly opposite phenomena, a very consistent purity for lint characters but diversity for growth characters. It was selected as a single plant from a Sakel bulk in an exactly similar way to Giza 7 from Ashmouni, and its parentage is equally obscure. Giza 7 differed radically from Ashmouni in both lint and vegetative characters, but Sakha 4 is hardly, if at all, vegetatively distinct from Sakel. The greater length, whiteness, and fineness of its lint might suggest Sea Island for the other parent, but this cross could not have given rise to the wilt resistance which is another character of Sakha 4. Perhaps Casuli could have been the parent. In any case Sakha 4, when first grown on, showed the same apparent purity as Giza 7, and was bulked about the same time. When its partial resistance to wilt was discovered, however, single plant selections were made with the object of getting complete immunity. This was successful, showing its original heterozygosity for this character. It may be mentioned here that every Egyptian variety that has been genetically examined for wilt resistance has proved heterozygous for this character, except Ashmouni, which is completely immune. Again the point arises, Why, in the evolution of a variety, is a condition of homozygosity not approached for the obscure qualities as rapidly as it is for the most obvious qualities? The strains raised from this selection have given, as mentioned, higher immunity to wilt, while all remain practically indistinguishable from the bulk Sakha 4 in both lint and general vegetative appearance. Two of them, however, have distinctly different physi-

ological reactions. One has a much more prolific flowering rate, but gives no higher yield because the shedding is relatively heavier. Another has given higher yields, but with a pronounced difference in locality preference, the yield being no higher in the north Delta where Sakel and Sakha 4 are mostly grown, but with a progressively greater difference towards the south Delta, where the strain gives yields markedly higher than those of Sakha 4.

The Ashmouni types have given not only different lint qualities, referred to in a Technical Bulletin of the Egyptian Ministry of Agriculture, but also appear to have locality preferences similar to the Sakha 4 case. Giza 2, the present Ashmouni stock, has been proved to be at its best only in Upper Egypt, north of Assiout. One of the lint-characteristic lines derived from it, Giza 19, while giving the same yield as Giza 2 over the bulk of this region, appears to grow equally successfully further south, and to be not quite so happy in the northern part of the district; in other words, its optimum district would appear to have a mean point further south than Giza 2. Another new lint-character selection from Giza 2, called Giza 22, moves in the other direction. It gives lower yields at the southern end of the Giza 2 range, but at Giza, the northern end, it seems to yield fully up to the other types. These locality differences exist in three strains which, when growing side by side, cannot be told apart from a general vegetative inspection.

These instances show the breeding possibilities of closer and closer examination of single plant strains of apparently pure varieties. In the article on the Purity Chequer, the writer described how such selections are now made at Giza from " positive aberrants " on the target diagram. A number of plants were selected from a target diagram of Sakha 4 in 1928, because their halo-length and ginning-outturn were above average, and the majority of these have proved to be genetically typical, but one has given a family showing both better lint and higher ginning outturn than Sakha 4. This family is typical Sakha 4 in general appearance, and cannot therefore be the result of another natural cross of Sakha 4. It can only be supposed to be the result of a continuous segregation which has been going on both before and since the first selection of the Sakha 4 type, and which is still throwing up material for new improved selections from an intricate complex of genes.

Received December, 1932.

ROTATION CROPS

[A discussion, based on work carried out at the Cotton Breeding Station, Barberton, South Africa, on the question of suitable rotation crops for inclusion in a cropping scheme having cotton as the main cash crop.]

BY

W. L. FIELDING, B.Sc., Dip. Agric.

" ROTATION of crops " has become a byword in present-day systems of arable farming. The reasons are patent and need but little discussion here, save to point out certain factors which make varied cropping specially advisable under South African conditions.

It is obvious that on land where the same crop is grown continuously the soil will, in time, become denuded of those elements of which the crop requires most. This impoverishment of available constituents will take place more quickly than the working down of the dormant, non-assimilable material into a state suitable for absorption by plants. It is therefore well to crop land with species of varying requirements so that a " balanced " demand is made of the soil, adopting the principle that a crop requiring much phosphorus, for instance, be followed by one requiring less phosphorus, and more of the other ingredients, such as potash or calcium.

Crops with different types of root system, shallow and deep, for example, when used alternately will help maintain texture and fertility, functioning in varying layers of the soil and subsoil.

Rotation of crops is of importance in minimizing damage by pests, both of the root and aerial portions of the plant. A small black beetle (*Syagrus rugifrons*) has done serious damage to cotton crops in South Africa, working below ground level and practically destroying root systems, the only remedy being a change of cropping. Work at Barberton on insect pest control has shown that American Bollworm (*Heliothis obsoleta*) seems to prefer maize as a host plant to cotton; the pest does relatively little harm to the maize, and as this crop seems definitely attractive to one of the cotton-grower's worst enemies, there should be some incentive to him to include it in his cropping scheme if for no other reason than to act as a trap crop.

In a country of erratic rainfall and general climate, such as South Africa, it is of importance to the farmer to have a range of useful crops. With constant liability to late rains, making the planting of long-period crops inadvisable, or to crops being wiped out by hail or

wind early in the season, he does not want to have "all his eggs in one basket." With a long-period crop such as cotton (six to seven months) he may require something to plant on odd lands after his cotton-planting is finished; or should his cotton suffer irreparably from the elements, he may wish to replant his lands with some crop late in the season, say December or January. Bearing these factors particularly in mind, the aim at Barberton has been to pick out strains of various crops capable of maturing in a fairly short time (three to four months).

The provision of home-grown food for native labour and cattle rations is an incentive to the growing of certain leguminous and cereal crops on a farm where cotton is the main crop.

Apart from home consumption, the selling of produce both on interior and export markets is one of the most difficult problems to be faced. Crops yielding produce adapted to market requirements are naturally being selected, but prevailing low prices make the introduction of these into a farming scheme very slow work. Owing to market prejudice some crops possessing desirable agricultural characteristics are debarred from extensive use by the farmer. For instance, a bean which is suited to conditions and is high yielding may be considered on the small side for native consumption or for the canning trade, whilst a rather larger relative fetching a high price on that market may be a poor proposition for the farmer owing to low yielding potentiality or susceptibility to insect pests. The beans may be of equal actual feeding value and of similar taste, there being no real rhyme or reason for the market preference save conservatism or the appeal of a larger, perhaps coloured, bean to the eye.

An extensive range of crops have been tried on the Corporation's South African stations, including maize, soya beans, sunflower, groundnuts, sorghums, and a miscellaneous range of legumes having possibilities. Following are brief notes on the agricultural and economic value of some of these crops, the selection of the most useful strains, and the fitting of them into a farming scheme having cotton as the main cash crop.

Maize (*Zea Mays*).

"Mealies" have long been a standby in South African cropping schemes. The Union's main crop is grown on the Highveld, and whilst much progress has been made in the breeding of suitable varieties for these areas, little attention has been given to maize problems on the Middleveld and Lowveld, in which areas the main

cotton belt lies. On the Highveld, varieties of the white flat type (*indentata*) predominate. These are long-period maizes (140 to 150 days), and if put in late on the Lowveld often produce a poor crop. It is probable that in the Barberton area maize will be grown rather for purposes of food for native labour and cattle than for export. The need is then for a white-grained maize suitable for grinding into "mealie meal," the standard native foodstuff, the selected variety being capable of maturing a satisfactory crop in a comparatively short period. Out of a large variety of maizes tried, a White Flint strain, which has been under observation at Barberton over three seasons, has so far seemed best suited to requirements. Last season it definitely proved its yield capabilities in a variety trial. White Flint produces a round white grain which crushes into a meal apparently very acceptable to the native palate. It belongs to the *indurata* group, which are of a shorter maturation period and more drought-resistant than those of the *indentata* group.

White Flint grain is of a lesser market value than grain of the large white flat type, such as is produced by Hickory King or Potchefstroom Pearl; these latter would probably be grown by a man out to farm maize as the principal crop. The main question, however, being that of rotation crops for the cotton-grower, who will give prior attention to his cotton (and in some cases tobacco), White Flint has been selected as probably the most suitable all-round type for a cotton-grower wishing to plant maize after his cotton, with a fair chance of obtaining a reasonable crop for feeding his native labour, even in an adverse season. About two tons of White Flint seed have been supplied to farmers in the Barberton area. It is also being grown on the Corporation's stations in Swaziland and Natal.

A maize of possible use, should export produce be required, is a small red-grained Peruvian type. Points in its favour are early maturity, high resistance to the "streak" virus disease which causes serious reduction in yield in very late-planted maize in this area, and its production of a grain well suited to United Kingdom markets.

Soya Bean (*Glycine max*).

The produce from this crop has great possibilities in the commercial world. The uses to which soya beans can be put include the manufacture of soft soaps, paints, linoleum, waterproofing liquid, toilet powder, enamels and waterproof goods. The residual "soya cake," after oil extraction, forms valuable cattle cake. Several firms in England and on the Continent are now producing soya products

for human consumption, the basic soya flour for these edibles being prepared by the Berzcellar process.

A very large number of soya bean varieties from different parts of the world have been tested on the Corporation's South African stations. Several have shown good yielding capabilities, but only one has proved of real use as a grain producer. This is the Barberton Y 1 strain, producing a fairly large, bright yellow bean, and owing its superiority to a high degree of resistance to shattering of grain when ripe. Oil content is in the region of 18 per cent. The beans make an attractive sample in appearance and are likely to prove generally acceptable from the market point of view. South African produce of this type has recently been reported on very favourably in comparison with the Manchurian soya beans customarily tendered on United Kingdom markets.

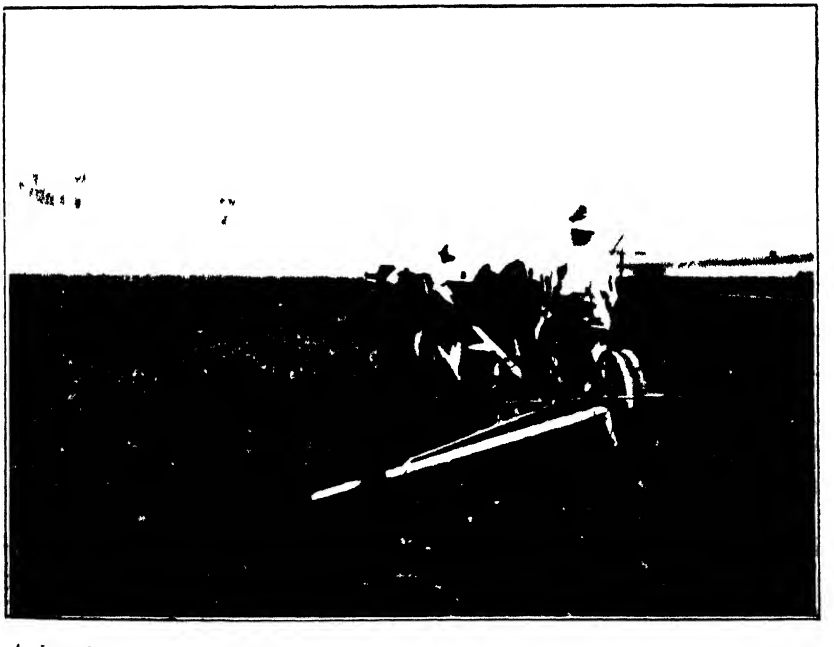
The soya bean has one big advantage in that it is the only bean crop which is not liable to serious damage by the large Cantharides beetle. This pest will often destroy the majority of the flowers on bean crops with exposed flowering systems; the flowers of the soya bean are borne in the axils of the branches and apparently owing to this obscurity within the foliage of the plant never suffer seriously.

Experiments at Barberton are giving useful information on the best spacing at which to grow soya beans, and on the best time to plant. Although South African soils as a whole are not considered deficient in nitrogen, there is always the need for keeping up nitrogen content on continuously cropped lands. It is this function which the leguminous crop in any rotation is expected to effect. In order that the soya bean shall fulfil this purpose, it is essential that the bacterium specific to the soya plant be present in the soil, so that it may infect the root systems and, working in "symbiosis" with the plant, fix nitrogen from the soil, air and moisture. The soya bean bacterium is not indigenous, and cultures have been imported with which to inoculate crops. A method of inoculating on a field scale with soil cultures of bacteria by means of a fertilizer attachment mounted on the planting machine is being tried out. The question of the influence of lime on the effectiveness of the bacteria and on the general growth and yield of soya beans is being investigated. An acid soil condition is known to be unfavourable to the bacteria, and it is a question of whether more satisfactory inoculation and thence nitrogen fixation would justify a farmer liming his lands.

The soya bean seems suited to Barberton area conditions and may prove a useful crop when produce markets recover. During 1932 there has been a sale of twenty-seven tons of Y 1 soya from

Caterpillar Tractor Ploughing at the Cotton Breeding Station, Barberton

(A time of ploughing experiment is being ploughed. This tractor is well adapted to the work of ploughing random block plots as it can turn in its own length.)



A Two Row Planter at Work at the Cotton Breeding Station, Barberton.

various growers to an oil-extracting company on the Rand. The price was naturally a low one, based on current London quotations, but such beginnings might later lead to the provision of a definite interior market for soya beans.

Sunflowers.

Some work has been done on spacing and the selection of an early maturing, good yielding strain of this crop. Sunflower seed is saleable in the interior for poultry food purposes, is exported in small consignments to Australia, and can be utilized on the home farm as crushed meal in the concentrate ration for dairy cattle. It is fairly drought resistant, apparently immune from any serious pest or disease in this district, and is easily handled.

Groundnuts.

Suitable varieties have been selected, but the crop does not appear to have great possibilities for the cotton-farmer in this area. In order to obtain a good return, it seems probable that the crop should be planted in October or November, owing to the subsequent serious incidence of " rosette " (*virus*) disease. This question is being further investigated in time-of-planting experiments, but a crop which required to be planted at the same time as cotton would be less useful than crops capable of later planting.

Miscellaneous Legumes.

A range of leguminous crops of suitable growth duration for fitting into a rotation with cotton are under observation. Apart from rotational value, they have varying uses, such as providing dried beans for home consumption as cattle food and native labour rations; for sale on interior and possibly overseas markets for native or European consumption; or the provision of a mass of foliage to be cut as cattle fodder or ploughed in as a green manure.

A small white bean, tepary (*Phaseolus acutifolius*), has proved the most prolific yielder in this class, and is well suited to requirements, maturing in two and a half to three months. Tepary bean is a native of Texas and Arizona, where it is reported an important crop. In the crushed form it should prove a useful component of concentrate rations for cattle. In the cooked form it appears acceptable to the South African native's palate. A gold-mine in the Barberton area feeds tepary beans to its native labour. Where labour gangs include a proportion of natives belonging to a non-meat-eating tribe, the question of supplying proteins by feeding a bean ration

becomes of importance. Good germination of this bean can be obtained under only moderate moisture conditions, the crop being quite an easy one to handle throughout.

Various kinds of *Phaseolus lunatus* (Lima, Madagascar, or butter beans) are being tried. They seem to have possibilities planted toward the end of the rains, and are worthy of extensive trial as they command a far higher market price than many beans, on United Kingdom markets, for European consumption.

Certain beans of the *Phaseolus vulgare* group (speckled sugar beans, large kidney beans, etc.), command good market prices, but so far have shown little promise of being more than odd crops in this area.

It has not been possible to do any definite work at Barberton on the effects of green manuring on ensuing cotton or maize crops, but sunnhemp (*Crotalaria juncea*) is probably about the most useful crop, sown broadcast and ploughed in at 2 to 3 feet high. It has an added advantage in that a group of bacteria capable of infecting the roots of sunnhemp are indigenous in the Barberton soil, so that besides acting as a green manure, the crop may be beneficial from the nitrogen point of view.

Types of velvet bean (*Mucuna*) have been found to produce a good crop for hay and green-fodder purposes.

Possible Rotations.

Two experiments have been laid down at Barberton this year in which cotton will follow cotton, soya bean, tepary bean, maize, sunflower and fallow respectively. The experiments are laid out as random blocks. The strains of crops used are those which seem most likely to prove the best standard lots, and it is intended that the trials shall be more or less permanent, so that studies of the growth of cotton after cotton itself, after one-year fallow, and after the various rotation crops may be made. The preliminary stages in the work of ascertaining what crops can be grown, the best spacing at which to grow them, etc., having been done, it is now for these rotation experiments to demonstrate the merits of the various crops.

Tobacco.

Tobacco is an important crop in the area, "Barberton snuff" being in demand by natives throughout the Union. Those farmers having good tobacco lands and sufficient irrigation water will probably adopt a simple tobacco-cotton-tobacco rotation. This is a specialized

side of farming, however, and the Corporation's work on rotations has therefore been directed towards the finding of crops for wider areas, and for lands where tobacco will not normally be grown.

SUMMARY NOTE.

It appears probable that maize and soya beans will prove useful standard crops; maize as a feed for native labour, and soya bean as a cash crop either on interior markets or, with more settled world conditions, for export. Beans suitable for native and cattle feed, or for the European dried bean market, may have places in the farming scheme, as also oil-producing crops (apart from soya bean), such as sunflower and groundnut, the former with the further possibility of immediate use as a cattle or poultry food, the latter for sale to natives locally. Farmers having a dairying business will need to include a certain amount of green fodder in their cropping scheme, and for the ordinary arable farmer the provision of pit silage, made from a broadcast crop of sorghums or maize, will prove useful for draught oxen when the dry season is a long one.

Received February, 1933.

COTTON STATISTICS

WORLD'S CROPS—AMERICAN AND EGYPTIAN

BY

JOHN A. TODD, M.A., B.L.

THE feature of the world's cotton supplies during the season which is now drawing to a close has been the reversal of the relative position of American and all other growths, for the American crop is again reduced to something like a normal average yield, while the total of Outside Growths shows a small recovery from last year's low figures. The result is that the world's total is the smallest since 1923 (and well below the pre-war peak figure of 1914), with the consequent recovery in the percentage of Outside Growths to the total. This result is very clearly shown by the movement of the lines in the diagram on page 125, which also bring out the fact that the world's total is still dominated by the American crop.

While, however, the American crop shows a marked reduction on the enormous figure of 1931, it will be seen from Table II. that the average yield, according to the December estimate, which may still be slightly raised, shows a distinct improvement on previous years and is, as a matter of fact, above the ten years' average. This comparatively good yield was apparently due to the fact that the weather in the latter part of the Fall was on the whole favourable, and boll-weevil damage turned out to be much less than was expected in the earlier estimates. It is also suggested that the very ample supply of labour this year was a favourable factor; and it must be kept in view that that is likely to continue at least during the coming season. It will also be noted that, as the result of the very large addition to the acreage figure in the December estimate, the net reduction from last year was again much smaller than economic conditions would have justified, being in fact only 7·2 per cent. on the revised figures of acreage planted.

The improvement in the total of Outside Growths is mainly due to China and to a smaller extent to Russia and India, but all these figures are, of course, only estimates at this stage of the season. Egypt, on the other hand, has suffered a considerable reduction,* mainly as the result of a further very heavy reduction in acreage (see Table IV.,

* The latest reports, however, indicate that the Egyptian crop may be a good deal higher than the Alexandria estimate used in Tables I. and II., say 5,000,000 kantars.

where the changes in acreage in recent years are shown as a percentage). Of the smaller Outside Growths Mexico shows the heaviest reduction.

Table III. gives the history of the Egyptian crop, and here there is a rather serious difficulty to be noted in the fact that the crop figures used are those of the Arrivals at Alexandria as given by the Alexandria General Produce Association, now known as the Minet-el-Bassal Bourse Commission. These figures, however, are the commercial crop, and in many cases they are substantially different from the crop actually grown during the season, because in certain seasons the Carryover up-country has been very heavy. In 1920, 1921 and 1922 the discrepancy was so serious that we gave effect to it by a rough approximation, and in 1926 the A.G.P.A. arrivals again were 8,635,000 kantars against the Government's final estimate of 7,652,000, so that the 1925 figures should receive an addition corresponding to the difference. This would, of course, affect the average yield for these two years.

Since 1928 the Egyptian Government have been publishing more and more information with regard to the crop founded on their ginning returns which not only give different figures of the total crop but also much more information as to the distribution between the different varieties. We have embodied all this information in Table IV., in which we have also given effect to a modification introduced in 1932 by the Government of the grouping of the different varieties according to staple, Long, Medium, and Short, for they have now transferred Casouli from Medium to Long Staple and Pilion and Giza 8 from Short to Medium. In 1931, for the first time they published in the final ginnings the crop details of all these varieties which we have given in the table, and it is hoped that they will do the same for 1932. It is understood that in these final ginnings they give effect to the necessary corrections for cotton from the previous crop which was not ginned till after the opening of the new season. Thus the final ginnings are the nearest approach we have yet had to the actual season's crop.

For the 1932 crop, of course, only the December estimate is available, but that shows several interesting features. In the first place, the total is 255,000 kantars less than the Alexandria estimate, and as there was a similar difference last year this cannot be put down to the up-country Carryover. The average yield of Sakel is the best since 1929, and the yield of other long-staple varieties also shows an apparent improvement; but the details of each variety within the group are not available. In the Medium staple group there is also apparently

TABLE I.—WORLD'S

(Bales of 500 Lbs.

	1914–15.	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.
America.						
U.S.A. Lint	16,135	11,421	13,440	7,954	9,762	10,140
Linters	857	608	440	397	608	668
Total	16,992	12,029	13,880	8,351	10,370	10,808
Mexico	125	200	194	145	191	160
Brazil	456	463	430	491	538	561
Peru	118	159	166	181	188	201
Argentine . ..	3	15	28	18	29	62
Others	8	9	11	45	26	67
Asia.						
India*	5,209	5,796	3,600	4,485	5,073	5,161
China	2,333	2,470	1,829	1,488	2,249	1,931
Japan and Korea ..	37	92	103	89	106	113
East Indies, etc. ..	23	20	31	27	26	21
Russia	1,244	200	66	42	52	214
Persia	140	122	102	95	63	79
Iraq, Ceylon, etc. ..	†	†	†	†	†	1
Asia Minor and Europe	140	114	106	45	39	78
Africa.						
Egypt	1,298	1,114	1,206	972	1,243	1,306
Sudan	19	19	24	19	23	38
East Africa (British)	34	43	75	49	80	119
South Africa (British)	1	2	2	2	5	9
West Africa (British)	12	13	24	12	13	21
Non-British	4	11	13	16	26	39
West Indies (British)	5	5	5	4	3	4
West Indies (Others)	11	17	11	22	17	17
Australia, etc. ..	†	†	1	3	7	10
World's Total ..	28,212	22,913	21,907	16,601	20,367	21,020
Outside Growths ..	11,220	10,894	8,027	8,250	9,997	10,212
Per cent. on Total ..	39·8	47·5	36·6	49·7	49·1	48·6

* Government Estimate, 400 lb. bales.

COTTON CROPS, 1914–1932.

(Approximately, 000's Omitted.)

1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.
								Estimates.
13,628	16,104	17,977	12,956	14,478	14,825	13,932	17,096	*12,727*
897	1,115	1,158	1,016	1,282	1,241	986	1,067	*850*
14,525	17,219	19,135	13,972	15,760	16,066	14,918	18,163	*13,577*
221	199	351	175	272	240	178	207	*91*
649	589	490	480	511	564	470	556	*500*
198	186	243	241	220	266	225	213	*215*
75	136	65	103	129	138	122	175	*175*
84	70	74	61	64	67	71	62	*60*
6,088	6,215	5,024	5,963	5,782	5,213	5,224	4,064	*4,250*
2,104	2,044	1,707	1,833	2,114	1,995	2,456	1,721	*2,300*
122	122	141	131	147	137	154	102	*130*
20	19	13	16	15	18	17	17	*17*
458	741	785	994	1,174	1,279	1,589	1,851	*2,000*
58	82	83	73	90	82	124	100	*100*
2	3	3	2	4	4	3	1	*1*
110	151	134	82	138	142	118	141	*142*
1,455	1,593	1,727	1,219	1,602	1,697	1,589	1,313	*890*
36	97	118	101	129	127	96	188	*120*
180	168	128	128	196	135	176	169	*170*
18	22	9	9	8	14	8	5	*5*
32	39	22	17	26	35	15	4	*5*
65	74	87	84	99	104	118	99	*100*
3	3	5	5	3	4	6	4	*3*
19	25	24	21	23	25	21	20	*25*
12	6	5	8	5	10	10	4	*5*
26,534	29,803	30,373	25,718	28,511	28,392	27,708	29,179	*24,881*
12,009	12,584	11,238	11,746	12,751	12,326	12,790	11,016	*11,304*
45·3	42·2	37·0	45·7	44·7	43·4	46·1	37·8	*45·5*

† Less than 500 bales.

TABLE II.—AMERICAN ACREAGE, CROP, YIELD PER ACRE, AND PRICE, 1911–32.

Season.	*Acreage Harvested* (000's).	*Crop* (*Running Bales*, 000's).			*Average Yield* (*Lbs. per Acre*) (*Ex Linters*).	*Average Price Middling* (*Pence per Lb.*).
		Cotton.	*Linters.*	*Total.*		
1911–12	36,045	15,553	556	16,109	207·7	6·09
1912–13	34,283	13,489	602	14,091	190·9	6·76
1913–14	37,089	13,983	631	14,614	182·0	7·26
1914–15	36,832	15,906	832	16,738	209·2	5·22
1915–16	31,412	11,068	945	12,013	170·3	7·51
1916–17	34,985	11,364	1,300	12,664	156·6	12·33
1917–18	33,841	11,248	1,096	12,344	159·7	21·68
1918–19	36,008	11,906	910	12,816	159·6	19·73
1919–20	33,566	11,326	595	11,921	161·5	25·31
1920–21	35,878	13,271	429	13,700	178·4	11·89
1921–22	30,509	7,978	382	8,360	124·5	11·37
1922–23	33,036	9,729	591	10,320	141·5	14·92
1923–24	37,123	10,171	640	10,811	130·6	17·66
1924–25	41,360	13,639	858	14,497	157·4	13·76
1925–26	46,053	16,123	1,044	17,167	167·2	10·77
1926–27	47,087	17,755	1,042	18,797	182·6	8·15
1927–28	40,138	12,783	875	13,658	154·5	11·17
1928–29	45,341	14,297	1,086	15,383	152·9	10·52
1929–30	45,793	14,548	1,038	15,586	155 0	9·09
1930–31	45,091	13,756	824	14,580	147 7	5·71
1931–32	40,693	16,629	876	17,505	201·2	4·82
1932–33	*37,589*	*12,700*	*750*	*13,450*	*162·1*	—

TABLE III.—EGYPTIAN AREA, CROP, YIELD, AND PRICE, 1914–32.

Season.	*Area. Feddans.* 000's.	*Crop. Kantars.* 000's (*A.G.P.A.*)	*Average Yield per Feddan* (*Kantars*).	*Season's Average Prices.*		*Sudan Crop. Kantars.* 000's.
				F. G. F. Brown. Pence per Lb.	*Premium over American Middling* (*per Cent.*).	
1914–15	1,755	6,490	3·70	7·34	40	95
1915–16	1,186	4,806	4·06	10 42	39	65
1916–17	1,656	5,111	3·10	21 56	75	92
				Sakel.		
1917–18	1,677	6,308	3·75	30·97	43	45
1918–19	1,316	4,821	3·66	27 85	41	64
1919–20	1,574	5,572	3·54	60·34	139	93
1920–21	1,828	6,030	3·30	30 24	154	122
1921–22	1,292	4,858	3·76	19·75	74	96
1922–23	1,801	6,213	3·45	17·29	16	113
1923–24	1,715	6,531	3·81	21·55	22	191
1924–25	1,788	7,274	4·07	29 82	117	180
1925–26	1,924	7,965	4·14	20·05	86	485
1926–27	1,786	8,635	4·84	15·39	89	592
1927–28	1,516	6,097	4 02	19·39	74	534
1928–29	1,738	8,012	4·61	18·14	72	684
1929–30	1,841	8,485	4 61	14 52	60	672
1930–31	2,082	7,947	3 82	9·06	34	514
1931–32	1,683	6,563	3·90	6·80	41	994
1932–33	1,094	*4,450*	*4·07*	—	—	*630*

Estimates in *italics*.

TABLE IV.—EGYPTIAN AREA AND CROP BY VARIETIES.

(The Crop Estimates Exclude Scarto.) 000's Omitted.

	1928.			1929.			1930.			1931.			1932.		
	Area: Feddans	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*
Long Staple:		Final Estimate			Final Estimate			Final Ginnings			Final Ginnings			Decr Estimate	
Sakel	800	2,533	3·17	848	2,695	3·18	837	2,109	2·52	479	1,317	2·75	369	1,080	2·93
Maarad	*	—	—	22	—	—	66	—	—	111	344	3·10	70	—	—
Giza 7	*	—	—	*	—	—	5	—	—	35	125	3·60	35	460	3·70
Sakha 4	*	—	—	*	—	—	*	—	—	4	13	3·26	2	—	—
Casouli	*	—	—	11	—	—	9	—	—	6	24	3·95	2	—	—
Group Total	800	—	—	881	—	—	918	—	—	634	1,823	2·87	494	1,540	3·12
Per Cent. of Total	*46·0*	—	—	*47·8*	—	—	*44·1*	—	—	*37·7*	—	—	*45·1*	—	—
Medium															
Nahda	26	—	—	44	—	—	25	—	—	53	154	2·89	29	—	—
Fouadi	*	—	—	14	—	—	33	—	—	40	98	2·48	17	—	—
Pilion	97	—	—	88	—	—	124	—	—	157	458	2·91	39	—	—
Giza 3	*	—	—	*	—	—	36	—	—	38	173‡	4·61	7	—	—
Group Total	123	—	—	145	—	—	219	—	—	288	883	3·07	92	354	3·85
Per Cent. of Total	*7·1*	—	—	*7·9*	—	—	*10·5*	—	—	*17·1*	—	—	*8·4*	—	—
Short															
Ashmouni and Zagora	768	—	—	804	—	—	936	—	—	759	3,499	4·61	507	—	—
Others†	47	—	—	11	—	—	9	—	—	2	11	5·05	1	—	—
Group Total	816	—	—	816	—	—	945	—	—	761	3,510	4·61	508	2,301	4·53
Per Cent. of Total	*46·9*	—	—	*44·3*	—	—	*45 4*	—	—	*45·2*	—	—	*46·5*	—	—
Total	1,738	7,847	4·51	1,841	8,329	4·52	2,082	8,082	3·88	1,683	6,216	3·69	1,094	4,195	3·84
Per Cent. Change in Acreage	*+14·7*	—	—	*+5·9*	—	—	*+13·1*	—	—	*−19·2*	—	—	*−35·0*	—	—
Lower Egypt	1,143	—	—	1,218	—	—	1,387	—	—	1,193	—	—	792	—	—
Upper Egypt	595	—	—	623	—	—	695	—	—	490	—	—	301	—	—
Per Cent. of Total	*34·2*	—	—	*33·8*	—	—	*33·4*	—	—	*29·1*	—	—	*27·6*	—	—

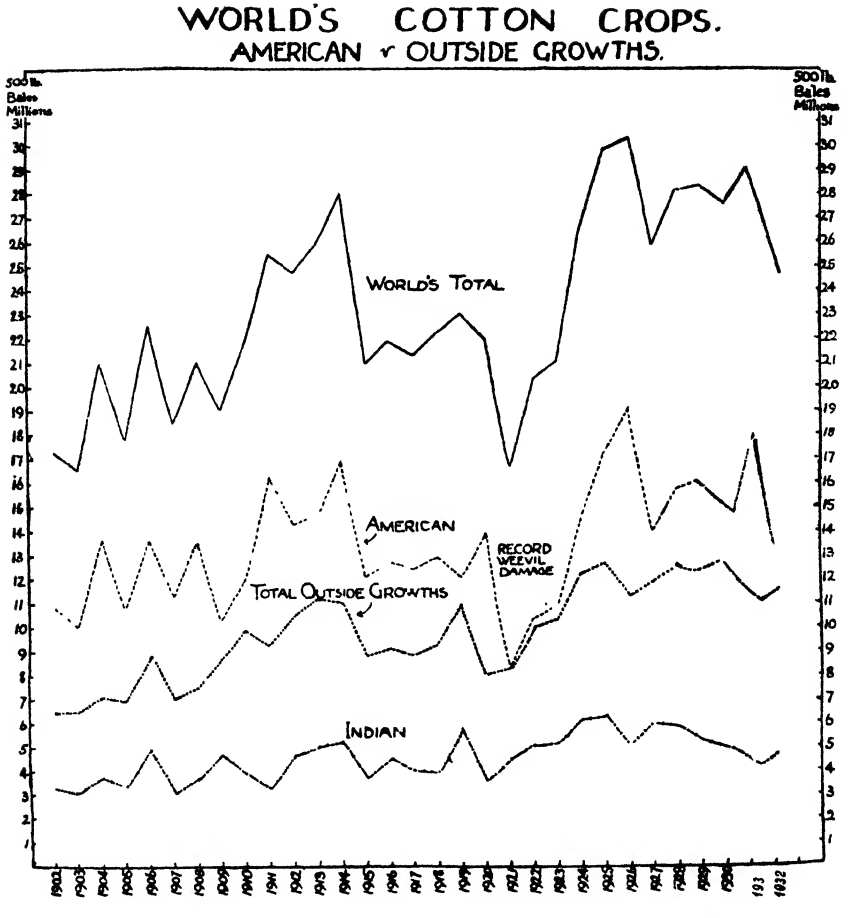
* Not shown separately. † Not necessarily all short. ‡ Our estimate.

a very marked increase in the average yield, but the short staples show a small decline. On the whole, however, the yield shows a small improvement on the low figure of 1931.

In the reduction of acreage, which has again been very marked for the crop as a whole this year, it will be noted that the Medium staple group shows the heaviest reduction of all, while the Long staple group has made a substantial relative gain. Giza 7 is the only variety in the whole table that shows an actual increase (35,086 feddans against 34,710).

The addition at the foot of the table of the total figures for Lower and Upper Egypt respectively brings out two interesting points: (1) the reduction of acreage in the last two years has been heaviest in Upper Egypt; (2) a comparison of the total area in Upper Egypt with the area under Ashmouni and Zagora shows the increasing extent to which these varieties have been encroaching on the Delta. It may be noted here that the legislative restriction of acreage for 1933 has been practically wiped out for all varieties except Sakel, and it seems to be generally expected that as the result the total acreage this year may be very close to the record figure of 1930.

With regard to the Sudan crop, it is very regrettable that, according to the reports now available, the serious trouble which overtook the crop in 1929 and 1930, but which had apparently been overcome in 1931, has reappeared this year. Up till January the Government very wisely declined to make any statistical estimate of the effect on the Gezira crop, but stated that "the season is unfavourable and yields will be under average." The estimate of 630,000 kantars for this year's crop which we have used in Table III. is based on an average yield of about 2½ kantars for the Gezira.


WORLD'S COTTON CROPS.
AMERICAN v OUTSIDE GROWTHS.
500 lb. Bales Millions
WORLD'S TOTAL
AMERICAN
TOTAL OUTSIDE GROWTHS
INDIAN
RECORD WEEVIL DAMAGE

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

167. INDIAN COTTON: USE IN LANCASHIRE MILLS. (*Man. Guar. Coml.*, **25**, 1932, p. 497. Abstr. from *Summ. of Curr. Lit.*, xiii., **2**, 1933, p. 24.) The views of a number of prominent spinners of coarse and medium yarns on the relative merits of Indian and American cotton are collected and summarized.

168. INDIAN COTTON: UTILIZATION IN LANCASHIRE. By H. Robinson. (*Text. Merc.*, **87**, 1932, p. 329. Abstr. from *Summ. of Curr. Lit.*, xii., **23**, 1932, p. 672.) Lancashire's reply to the Indian cotton-growers' contention that much larger quantities of Indian cotton could be used by Lancashire spinners in place of the shorter-stapled American cotton.

169. THE INDIAN CENTRAL COTTON COMMITTEE: ITS OBJECTS, ACTIVITIES, AND ACHIEVEMENTS. (Bull. received from the Publicity Officer, Ind. Cent. Cot. Comm. 1933.) This useful bulletin gives a brief résumé of the objects for which the Committee was constituted, its chief functions, and its varied activities. The most noteworthy achievements of the Committee to date are: the enforcement of the Cotton Transport Act and the Cotton Ginning Act, and the passing of a bill for the standardization of weights and measures. The important work carried out at the Technological Laboratory at Matunga, and at the Institute of Plant Industry at Indore, is briefly described, and other matters discussed include: the results achieved by the various agricultural research schemes and seed extension schemes financed by the Committee; the Cotton Cess Act, passed in 1923 to provide funds for the Committee's work; the fumigation of American cotton to avoid the introduction of foreign pests into the country. The bulletin is furnished with several good illustrations.

170. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

"The Indian Central Cotton Committee," dealing with the work of the Committee in Bombay and Sind.

"Campaign against Cotton Wilt Disease in the Central Provinces." Successful work has been carried out in the isolation and development of two new high-yielding and wilt-resistant strains of Verum 262, which have been called "Late Verum" and "Early Verum."

"Promising Results of Dharwar Wilt Research Scheme." Discusses the following: the breeding of wilt-resistant strains of cotton, the influence of soil temperature on the virulence of wilt attack, and the most favourable time of sowing for the Karnatak.

"'Greenstained' Sind-American Cotton." Green stain is caused by the removal in ginning of thick green fuzz from the seed. The results of tests show that yarns spun from stained cotton are almost as strong as those obtained from unstained, and are indistinguishable from the latter after undergoing normal bleaching treatment.

"Madras Herbaceum Scheme." Summarizes the work that has been accomplished in developing a strain of cotton possessing the yield and spinning quality of Karunganni, with the colour, lint, and well-developed root system of Uppam cotton.

"Impurity in Tenderable Quantity in Indian Cottons." Deals with the inauguration of seed distribution schemes to ensure a wider distribution of improved varieties of cotton.

171. Spinning Test Reports on East African and Indian Cottons. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 81, 84, and 85, 1932-33.) The circulars contain the grader's report and spinning test results for the East African cottons—A. R. Kampala, A. R. Busoga, and A. R. Jinja—and the Indian cottons—Bengals, Ujjain, Khandesh, and Moglai—for the 1932-33 season.

172. Technological Reports on Standard Indian Cottons. By N. Ahmad. Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks and Conclusions.

1. *Punjab-American* 289 *F.*—Area under cultivation in 1931-32, 18,000 acres. Except for the neppiness of its yarns, this season's cotton has generally given good results. It is suitable for 44's warp.

2. *Verum* 262 (*Akola*).—Area under cultivation, 1931-32, 164,800 acres. This season's cotton is superior to that of the two previous seasons, and has so far given stronger yarns than in any other season. It is suitable for 25's warp.

3. *Umri Bani.*—Area under cultivation, 1932-33, 187,500 acres under Government seed, 473,567 acres under cultivators' seed. This cotton has maintained the improvement in spinning performance noticed since 1929-30. It is suitable for 28's warp.

173. Technological Report on Banilla Cotton, 1930-32. By N. Ahmad. (*Tech. Bull.* No. 22, Ser. A., Ind. Cent. Cott. Comm., 1932.) Contains the results of tests on twenty-five field samples of Banilla cotton grown in 1930-31 and 1931-32 in different parts of Khandesh. Results of tests on samples received since 1926-27 from the Government Agricultural Farms at Dhulia and Jalgaon in Khandesh are also included for purposes of comparison. The following conclusions are presented:

1. In the same season the mean fibre-length and the fibre-weight per inch of Banilla cotton grown in different parts of Khandesh may show considerable variation as between one sample and another. According to the coefficient of variation test the cotton is "very variable" in respect of mean fibre-length and "variable" in respect of fibre-weight per inch.

2. In different seasons samples of Banilla cotton grown at the same place may show large differences in respect of either of the two above-mentioned fibre-properties.

3. The average values of mean fibre-length and fibre-weight per inch for the 1930-31 crop are 0·73 inch and $0{\cdot}180 \times 10^{-6}$ oz. respectively.

4. Yarns spun from the Banilla cotton are generally "even" in 12's and "fairly even" in 16's counts. In most cases yarns are practically free of neps.

5. The average performance of the present-day Banilla crop corresponds to 14's standard warp counts. As in the case of fibre-properties, however, some of the samples have given decidedly better, others poorer, results than the average.

6. The Banilla cotton is, on the whole, somewhat longer and appreciably finer than the local (N.R.) Roseum cotton, and is generally capable of being spun into higher counts.

7. On the whole, samples grown in East Khandesh have given a better performance than those grown in West Khandesh.

174. "Bombay Cotton Annual, 1931-32, No. 13." The usual authoritative compendium of all matters relating to the Cotton Trade, issued under the authority of the East India Cotton Association, Ltd., Bombay. It contains

statistics of crops, exports, imports, prices, stocks, consumption, Government notifications, etc., that should prove of use to all those interested in the production, distribution, and consumption of Indian and foreign cottons, yarn, and cloth.

175. MADRAS. *Cotton Cultivation*, 1931-32. (*Rpt. on Operations of the Dpt. of Agr.*, 1931-32.) The most important work in connection with cotton consisted in the distribution of strains of Co. 2 (Cambodia), C. 7 (Karunganni), H.I. (Western), and N. 14 (Northern) cottons to the various centres. In addition, selection work with Cambodia, rotation, time of sowing, and manurial experiments were carried out.

The Cotton Ginning Act and the Cotton Transport Act continued in force during the year.

176. PHYSIOLOGY OF THE COTTON PLANT IN SIND, WITH SPECIAL REFERENCE TO PERENNIAL IRRIGATION. (*Bull.* recd. from the Publicity Officer, Ind. Cent. Cott. Comm., 1933.) A popular account of the work carried out by the Sind Physiological Research Scheme at Sakrand. The various chapters deal with the climatic conditions at Sakrand, and incidence of insect pests and diseases of cotton in Sind; sowing date experiments; water experiments; study of soil conditions in relation to the growth of cotton under different water treatments; study of different varieties.

177. THE KHANDESH COTTON BREEDING SCHEME, 1926-32. (*Bull.* recd. from the Publicity Officer, Ind. Cent. Cott. Comm., 1933.) This bulletin deals with the results of experiments carried out at the Dhulia and Jalgaon farms on the culture, isolation, and purification of *Neglectums* and *Banilla* cottons. Illustrations of the two varieties are included.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

178. The following reports have recently been received:

"The Journal," South-Eastern Agricultural College, Wye. January, 1933.
FIJI: Agr. Journal, 1932.
NIGERIA: Ann. Rpt. of Northern Provinces, 1931.
QUEENSLAND: Ann. Rpt. of Dpt. of Agr. and Stock, 1931-32.
TANGANYIKA: Ann. Rpt. of Dpt. of Agr., 1931.
4th Ann. Rpt. East Afr. Agr. Res. Sta. Amani, 1931-32.
WEST INDIES: *Trinidad and Tobago.* Admin. Rpt. of Dir. of Agr.,1931.

179. REPORTS RECEIVED FROM EXPERIMENT STATIONS, 1931-32. (Published by the Empire Cotton Growing Corporation. Price 2s. 6d., post free.) In accordance with the rotary scheme, which was described in last year's preface, four only of the Experiment Stations supply full reports, and these come this year from Northern Rhodesia, Nyasaland, Nigeria and Fiji. The remainder of the Stations send summaries of the principal results obtained.

An account is given of the extensive breeding work that is going on, and, as in former years, the success of U4 and its derivatives in South Africa and the colonies to the north of it constitutes one of the most interesting features of the report. Much useful work is described dealing with rotation of crops, intercropping, spacing, time of planting, and time of ploughing experiments; pests and diseases and their control. In addition, various other items in the cultivation and preparation of cotton have also been the subject of investigation, *e.g.*, the delinting of seed in Queensland, interchange of seed in Uganda, topping in Nigeria and Fiji, use of cattle in Nigeria. The reports should prove of interest and use to all those concerned with the breeding and cultivation of cotton and similar crops.

180. LIST OF AGRICULTURAL RESEARCH WORKERS IN THE BRITISH EMPIRE, 1931. CORRIGENDA AND ADDENDA, 1932. (H.M. Stat. Off., 1932.) The annual revision of the list showing the names of agricultural research workers and their investigational subjects as on June 30 each year. For purposes of economy the present volume takes the form of Corrigenda and Addenda to the 1931 Edition, to make that List correct as on June 30, 1932.

181. EMPIRE COTTON GROWING. PRODUCTION AND CONSUMPTION. By J. A. Todd. (*Trop. Agriculture*, x., 2, 1933, p. 43.) A very informative paper on the subject, with useful illustrative tables. The abnormal conditions prevailing in the American cotton industry during the last few seasons are discussed. The author states that "it was to be expected that the very low level of American cotton prices would prove a serious discouragement to the Empire cotton fields, but the actual reduction in the Empire crops has not been very serious, except in the case of India, where the reasons are not mainly associated with prices." In regard to the new cotton fields of the Empire, he writes as follows: "In all the struggle for the survival of the fittest, the cottons from the Empire's new fields are very favourably placed. Sea Island cotton from St. Vincent and St. Kitts is still the very best of the Sea Island supply. Sudan Sakel is equal to all but the very best of the Egyptian Sakel crops, and is now quite a serious rival to it in terms of quantity. The American cotton grown in East Africa compares favourably with the best of the Upland types grown in America even in the Mississippi Delta, while even in India the very marked improvement since the war in the supplies of what are there regarded as long-staple cottons, *i.e.* above $\frac{7}{8}$ inch, has enabled India normally to supply her own needs for that class of cotton. Thus the Empire has a finger in every pie, and is therefore in a position to weather the storm of the present depression better than any other single cotton-growing country."

182. ASIA: IRAQ. *Cotton Cultivation.* (*Int. Cott. Bull.*, xi., 42, 1933, p. 183.) Cotton cultivation in Iraq has shown a decline during recent years. The country produces two varieties of cotton—the short-staple Levantine type, which is grown mainly for domestic consumption, and American Upland, grown mainly for export to Great Britain. There are no spinning mills in the country, and the Levantine cotton is used exclusively for pillows, mattresses, and upholstery.

183. AFRICA: NIGERIA. *Cotton Cultivation in the Northern Provinces.* (*Ann. Rpt. of N. Provs.*, 1931, recently received.) The total purchases of cotton amounted to 4,400 bales. The opening price of 0·5d. per lb. was the lowest on record, but it rose later to as much as 1·1d. per lb. A good proportion of the crop was purchased for the local weaving industry, the price paid being higher than the export price.

The work of the Agricultural Department was greatly handicapped during the year by the necessity of having to send every available officer on locust work for several months.

Mixed farming continued to make steady progress, and some forty new farmers were anxious to give it a trial.

184. NYASALAND. *Cotton Prospects.* A report from H.M. Eastern African Dependencies Trade and Information Office is to the effect that the cotton crop is of very good quality, and 90 per cent. of that so far brought in has been of No. 1 grade. The good results obtained are due to the excellent yield of the U4 seed. It is anticipated that the total crop will approximate 3,000 bales.

185. SOUTH AFRICA. *Cotton Cultivation*, 1931-32. (*Farming in S. Afr.*, vii., 80, 1932.) The low price paid for cotton, in common with most other agricultural produce, caused a decreased acreage to be planted, and this fact, coupled with

the serious drought experienced during the season, resulted in a poor crop. Most of the cotton is grown in the Orange River irrigation area, but it is not expected that large quantities will again be produced there until the price rises to about 6d. per lb. On the experimental plots at Kakamas phenomenal yields of 7,000 lb. of seed cotton to the morgen were obtained, which shows the suitability of this area for cotton.

The forecast of a much lower American crop compared with that of the previous year resulted in a jump in prices of nearly 50 points, and if there be a further improvement, it can safely be anticipated that growers in the Union will increase their acreage for the 1932-33 season.

Research and experimental work continued to be vigorously pursued at Rustenburg and Barberton experiment stations. The Secretary for Agriculture states that "the Empire Cotton Growing Corporation is still doing good work in the Low Veld, and it is gratifying to report that there is cordial co-operation between the Corporation and the Department."

186. *Cotton Cultivation*, 1931-32. (*Crops and Markets*, xi., **4**, 1932.) The acreage under cotton was considerably reduced owing to the low prices ruling at planting time. Weather conditions generally were not favourable. Except for two or three districts, planting rains were late and the rainfall very low and badly distributed throughout the growing season, drought conditions being reported in some districts, which, together with intense heat, caused considerable damage to the cotton crop. A notable and gratifying feature was the marked absence of insect pests, isolated districts only reporting any damage, and this was practically confined to irrigated lands, except the Orange River area.

Prospects for 1932-33. Owing to the continued low prices prospects of a larger crop for 1932-33 are poor. Farmers, however, are still very interested in cotton, and with an improvement in prices, it is expected that the acreage would be considerably increased throughout the country.

187. SOUTHERN RHODESIA. *Cotton Cultivation.* (*Rhod. Agr. J.*, xxix., **12**, 1932, p. 946.) It is anticipated that cotton cultivation will again make headway as soon as there are any indications of an advance in prices. There is no doubt that in the U/4 derivatives, which have been bred up at Gatooma, growers are in possession of cottons admirably suited to the country. But for the incidence of bollworms and stainers yields would be heavier and better than they are at present, and even at today's low prices would give a fair return. Cotton has the advantage of not requiring applications of artificial fertilizer, and it does not exhaust the soil. The latest strains which have been produced at the Cotton Breeding Station give promise of heavier yields. These are being tried out in the districts this year on small plots, but will not be available for general distribution until they have demonstrated their adaptability to the respective areas where their behaviour is being observed.

188. SUDAN. *Cultivation of Sakel Cotton.* By R. Hagen. (*Wirtschaftsdienst*, **17**, 1932, p. 1664. Abstr. from *Summ. of Curr. Lit.*, xiii., **2**, 1933, p. 22.) The year 1931 was a very bad one for the cotton industry in the Sudan, owing to economic conditions and to Blackarm disease. Considerable improvement was made in 1932, and the yield of Sakel in the Sudan amounted to 83·7 per cent. of that in Egypt. Details are given of developments in other industries and in transport.

189. TANGANYIKA. *Cotton Cultivation*, 1931. (*Ann. Rpt. of Dpt. of Agr.*, **1931**, recently received.) The crop of 1931 was considerably less than that of the previous year. Cotton cultivation had declined in favour with the native grower in the Tabora and Lindi areas, and in Biharamulo it was unsuccessful. Seed

multiplication of the U/4/4/2 variety from Barberton was pressed on, and it was anticipated that when this hardy and heavy yielding strain could be generally introduced, cotton cultivation would again become popular in the Tabora Province. In the Eastern and Mwanza Provinces the crop was extensively cultivated, but in the former area the low prices offered and the depredations of field mice resulted in much of the seed cotton being unharvested. Cotton growing in these Provinces was being strongly encouraged, and it was hoped that the 1932 crop would show a considerable increase.

During the year Mr. Milligan, of the Empire Cotton Growing Corporation, visited the Eastern Province and Mwanza with a view to advising the Government in regard to the steps to be taken to effect improvement in the uniformity and quality of the cotton crop of the Territory.

The Cotton Advisory Board, which includes representatives of the industry from the leading cotton centres, continued to function in an extremely satisfactory manner. The cotton cess, which was imposed with a view to effecting payment for cotton seed, transport costs, and market supervision, did not prove entirely satisfactory in the Eastern Province owing to the difficulties of collection. The question of the future of the cess is under consideration by the Cotton Advisory Board.

190. *Cotton Experiments*, 1931. (*Ann. Rpt. of Dpt. of Agr.*, 1931.) The following experiments were carried out at the various stations: Time of planting correlated with spacing, ratooning, and mixed cropping experiments at Ibadakuli; time of spacing experiments at Mikidani; varietal trials at Mpanganya. The results of the trials at Mpanganya were not significant as field rats and mice were very destructive, and elephant and eland also caused considerable damage. At the Morogoro station manurial trials were carried out, and also varietal trials, in which seven strains of U/4 from Barberton were tried against the local cotton. In this experiment two strains of U/4—U/4/4/10 and C/15—were significantly superior to the local variety. Under Morogoro conditions U/4/4/10 is a tall-growing plant, with an open branching habit, the branches practically all sympodia; C/15 is a much shorter type, and tends to throw rather more vegetative branches.

191. *Cotton Prospects.* (*Int. Cot. Bull.*, xi., **42**, 1933, p. 187.) A recent report states that the quality and the quantity of the crop is generally satisfactory.

192. *East African Research Station, Amani, Tanganyika.* (*4th Ann. Rpt.*, 1931-32.) Contains the reports of the Director, Plant Pathologist, Soil Chemist, Biochemist, Plant Physiologist, Plant Geneticist, Systematic Botanist, Superintendent of Plantations, and the Secretary and Librarian. Satisfactory progress, fully commensurate with the working capacity of the Station, has been made in every section. The most important addition to the equipment of the Station is the provision in the road to Amani of an entirely new section which displaces, over a distance of some ten miles, the most difficult and trying parts of the old road, and substitutes a track with long easy gradients and wide curves. Provision has been made during the year for the supply of direct electric current and of distilled water in adequate quantities to the Station.

193. UGANDA. *Cotton Production*, 1932-33. (*Crown Colonist*, iii., **14**, 1933, p. 31.) "It is stated that Uganda is on the eve of a record cotton crop. According to the official bulletin of the Agricultural Department at the end of October, there were 1,070,152 acres planted to cotton, compared with 865,259 acres planted last season. Weather has been ideal, and there has been remarkably little disease. There is every indication of an average crop throughout, and the crop is generally estimated at 225,000 bales, although some people consider it will be from 240,000 to 250,000 bales. All this is the result of intensive propaganda work by the combined

British and Native Governments, the chiefs having taken the matter very seriously, travelling over their districts and seeing for themselves that each individual has planted more cotton."

194. *Crop Prospects.* The latest report from the Department of Agriculture states that favourable conditions for the maturation of the crop have been maintained, and a total production of 275,000 bales is estimated.

195. AUSTRALASIA: QUEENSLAND. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr. and Stock*, 1931-32, recently received.) From this report we learn that: "Adverse climatic conditions and a change in fiscal policy were the main factors in reducing the cotton output to a point lower than it has been for several years. This was unfortunate, for the continuation of a graduated bounty on yarns, tariff, and exchange rates provided a market stimulus to the industry in the previous year, especially in respect to its spinning side. As a consequence, the whole of the 1930-31 production of lint (1,891,119 lb.) was purchased for use in Australia. That fact, together with further demonstrations of the benefit derived from the ownership of the ginneries and oil mill, along with the low prices ruling for other agricultural products, increased interest in cotton-growing to a remarkable extent. In round numbers, 5,000 growers applied for seed sufficient to plant at least 65,000 acres—a record acreage for the State. Unfortunately, the early favourable prospects of a good season for cotton did not long continue. In the midst of the serious climatic difficulties the flat-rate duty on yarns was abolished. All purchasing contracts for Queensland cotton were terminated immediately by the spinners, and the financing of first advances on the crop could only be arranged on an export basis. After negotiation, a graduated tariff on all imported yarns was imposed in place of the bounty on the home product. Spinners were thus enabled to buy the Queensland crop on a basis assuring the growers average prices only slightly lower than those of the previous season. Unfortunately, owing to the exceptional weather experienced, the crop will be far short of spinners' requirements, and the shortage will have to be made up by imports." It was noted that cotton withstood the weather better than any other crop, and had there been one good soaking rain in early February, profitable returns would have been obtained by many growers. The quality of the crop exceeded expectations, and indicated that some success had attended the breeding experiments directed towards the development of drought-resistant characteristics in the cotton plant.

In spite of the experiences of the year, interest in cotton-growing was only slightly diminished. Growers appreciated the drought-resistant qualities of the plant, and in many cases acreages were increased.

Work at the Callide Cotton Research Station was continued in a season of the smallest rainfall for sixty years. The outstanding feature of the work was the demonstration of the value of growing cotton in rotation with summer fodder crops and fallows. The increasing of the stocks of seed and the testing of the more recently imported medium-stapled cottons were continued. It was thought that some of the new cottons might eventually prove of considerable value.

During the year the cotton crop suffered little injury from pests, with the exception of the rough bollworm (*Earias huegeli*, R.), which caused more damage than ever before. Corn-ear worm (*Heliothis obsoleta*) and stainers were also present, but not in serious numbers.

196. *Cotton Prospects*, 1932-33. (*Int. Cott. Bull.*, xi., **42**, 1933, p. 181.) The latest report states that good weather has been experienced in nearly every section of the cotton belt, and the prospects for the coming season's cotton crop are excellent. Up to date seed to plant 73,000 acres has been distributed by the Cotton Board. This represents a record for the State, and is 10,000 acres in excess of that at the same period last year. It is estimated that the final acreage will be about 80,000 acres.

197. *Cotton Cultivation.* By R. W. Peters. (*Queens. Agr. J.*, xxxviii., 1932, pp. 426 and 443.) A continuation of radio talks to cotton-growers in Queensland, dealing with time of planting; rate, depth, and method of sowing; spacing of rows; and cultivation methods.

198. FIJI. COTTON INDUSTRY. (*Agr. Jour. Fiji*, v., 2, 1932, p. 57.) It has been decided to suspend commercial cotton-growing for one year pending the change-over from Sea Island cotton to a new variety, for which there may be a better demand. During that year the new strain developed at the Cotton Experimental Station will be planted on selected Fijian farms, and by the end of 1933 it is hoped to see a profitable revival of cotton-growing in the country.

199. WEST INDIES. COTTON CULTIVATION. (*Trop. Agriculture*, x., 1, 1933, p. 21.) "The area under cotton in St. Vincent, Nevis, and Barbados is much reduced, and is below the quota approved by the Barbados Conference. The germination and subsequent growth of the crop is satisfactory, and in St. Vincent, where close attention is now being given to the question of seed supply, the uniformity of the stand is remarkably good. The excellent results that have followed the re-opening of the Cotton Research Station in St. Vincent, which was made possible by the generosity of the Empire Cotton Growing Corporation, have stimulated the arrowroot planters to create a similar organization to look after the interests of the arrowroot crop."

200. COTTON CULTIVATION IN WEST INDIES. (*Man. Guar. Coml.*, 31/12/32.) Deals briefly with the cultivation, picking, and ginning of Sea Island cotton.

201. WEST INDIAN COTTON-GROWERS' ASSOCIATION. (*Trop. Agriculture*, x., 1, 1933, p. 24.) The Commissioner for Agriculture has been informed that the cotton-growers of St. Kitts have formed themselves into an Association, and similar steps have been taken in Montserrat. In Antigua, the Cotton-Growers' Association, which has been in existence for many years, will constitute the local Association, and in St. Vincent it has been suggested that the Agricultural and Commercial Society should form a sub-committee to deal with cotton matters, and to carry out the duties of a Cotton-Growers' Association. The formation of these local Associations is a preliminary step towards the formation of a West Indian Cotton-Growers' Association, which was recommended by the Barbados Conference held in March last.

202. ST. VINCENT. *Cotton Prospects.* The latest report received from the Dept. of Agriculture states that the cotton crop looks fairly satisfactory, but too much rain has been experienced for its general well-being. Stainers have made their appearance.

COTTON IN EGYPT.

203. EGYPT. *Renewal of the Cotton Tax.* (*Int. Cott. Bull.*, xi., 41, 1932, p. 83.) The Council of Ministers, on the proposal of the Ministry of Finance, has approved a decree renewing for a further period of one year the decree issued on September 8, 1931, reducing the cotton tax to P.T. 10 per kantar. The new decree came into force in August last.

The cotton tax was first imposed on April 18, 1920, when the Government fixed a tax of P.T. 35 per kantar on all classes of Egyptian cotton. On September 2, 1922, this was reduced to P.T. 25, and Scarto was exempted from the tax; on September 17, 1926, it was brought down to P.T. 20 per kantar, and on September 8, 1931, it was again reduced to P.T. 10, and this figure has now been renewed for a further period of one year.

204. EGYPTIAN COTTONS: INTRODUCTION AND DETERIORATION. By P. R. Schwartz. (*Bull. Soc. Ind. Mulhouse*, 98, 1932, p. 473. Abstr. from *Summ. of*

Curr. Lit., xiii., **1**, 1933, p. 1.) The different varieties of cotton, which have in turn, since 1823, been introduced in Egypt and then abandoned owing to deterioration, are discussed. Graphs and charts showing averages and yields of the different varieties are given. The need for a few stable varieties, and the importance of control of seed selection and distribution and of methods of cultivation, are pointed out.

205. Possibilities of Gizeh 7 Cotton. (*Int. Cott. Bull.*, xi., **42**, 1933, p. 209.) During the last two years attention has frequently been drawn to the possibilities of this cotton, which is almost equal in strength to the very best Sakel. Spinners have of late been attracted to Gizeh 7, and much of the present season's crop of some 20,000 bales has already been sold. It is expected, however, that a larger quantity will be produced next year.

206. Investigation in Egyptian Cottons. By A. I. Avtonomov. (*Stud. Turkestan Plant Breed. Sta. Nihi. Sci. Ser.*, No. 9/3, 1930. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 65.) The Sea Island cotton examined proved to be very heterogeneous in time of maturity and lint quality, certain individuals being as late as Sakellaridis, which also contained a certain number of early plants. These latter, however, were on the whole also inferior in lint qualities. A series of experiments was designed to study the possibility of obtaining early Egyptian types and a comparison of the growth phases and boll and lint production of Ashmouni and Upland types. Certain of the selected Upland types combined increased earliness with lint length equal or superior to the original stock. One line from Janovich was seven to eight days earlier, with a lint length of 35·4 mm.; another from Ashmouni was three days earlier, with lint 3 mm. longer than the original, giving yields 70 to 80 per cent. of that of the standard variety Triumph Navrotskii.

COTTON IN THE UNITED STATES.

207. Report of the Chief of the Bureau of Plant Industry, U.S.A., 1931-32. *Cotton.*—A general effort is being made throughout the Cotton Belt to establish and maintain larger supplies of good seed in organized communities where all the growers plant the same variety of cotton, so that the seed of different varieties is not mixed at the gin, and the plants are not cross-pollinated in the fields. This work is being done under co-operative arrangements with the American Cotton Co-operative Association, and with the State Experiment Stations and extension services of several of the cotton-growing States. The tendency in many districts toward careless planting of inferior varieties and mongrelized stocks undoubtedly has had adverse effects upon the American cotton industry, but measures for improvement are being applied to a greater extent than ever before.

208. American Cotton: Grading. By H. H. Willis. (*Cotton* [U.S.], **98**, No. 12, 1932. Abstr. from *Summ. of Curr. Lit.*, xiii., **3**, 1933, p. 60.) This article points out the importance of proper classing and grading by the mill's cotton buyer. It also explains the meaning of grade, length, strength, and uniformity of staple and character, and describes the practice of the U.S. Department of Agriculture with the "Universal Standards." The average percentage of "total visible waste" in the nine grades is plotted on a graph.

209. American and Egyptian Cotton. By H. E. Ahmed Wahab Pasha. (*Egypt and Sudan Ann.*, 1932.) Discusses the effect on the United States and Egypt of the duty of 7 cents per lb. on all imports of cotton of staple longer than $1\frac{1}{8}$ inches, imposed by the United States in June, 1930.

210. Making Cotton Cheaper: Can Present Production Costs be Reduced? By M. G. Vaiden *et al.* (*Miss. Sta. Bull.* 298, 1932. Abstr. from *Exp. Sta. Rec.*, 67, **6**, 1932, p. 761.) Some of the conclusions of the authors are that (1) the

15-acre-per-family units can never again on the average be profitable even in the Delta area; (2) part of the power now supplied by man must be replaced by mules and machines; (3) from 30 to 50 per cent. of the present farm labour must be replaced by machinery if plantations are to escape foreclosure; (4) putting labour on a cash or day basis will increase its efficiency 50 to 100 per cent.; and (5) mechanical harvesting equipment can reduce operating labour 75 per cent. from that with 1-mule method requirements.

211. ARIZONA. *Experiments with Egyptian Cotton.* (*Rpt. of Chief of Bur. of Plant Indus.*, 1932, U.S.A.) Earlier experiments carried out in Arizona with Sakel cotton were not successful, this variety proving less productive, later maturing, and smaller bolled than Pima. In the hope of combining the desirable characters of these two varieties, crosses were made between Pima and Sakel, and from one of these crosses a new variety of considerable promise has been developed. It will not take the place of Pima, since the lint is only 1½ inches in length, but it is thought possible that it may replace some of the cotton at present imported from Egypt.

212. ARKANSAS. *Cotton Variety Tests.* By J. O. Ware. (*Bull.* 282, *Agr. Exp. Sta., Arkansas*, 1932.) Gives the results of comparative tests of various cottons with Arkansas Rowden 40, carried out in the north, south, and east areas of Arkansas during 1925-31 inclusive.

213. CALIFORNIA. *Cotton Cultivation*, 1932. (*Ann. Rev. of S. California Crops*, 1932.) The acreage planted to cotton was 123,000 acres, and the estimated yield is 126,000 bales. This is slightly in excess of 1 bale to the acre, and is due to the planting of seed of much better quality than had been the case in previous years.

214. SOUTH CAROLINA EXPERIMENTS. (*Int. Cott. Bull.*, xi., **42**, 1933, p. 195.) Recent experiments undertaken by the U.S. Dept. of Agriculture indicated that cotton which has remained open in the field for eighteen days or more can no longer, on an average, be classed as white. During the course of experiments recently carried out by a South Carolina plantation for the purpose of determining how long cotton may be safely left out in the field, newly opened bolls were marked. Cotton was picked from some bolls each day over a long period, and tested for change of colour. During the first two weeks samples picked were graded strict good, or good middling, white or spotted. The last sample graded in the white grades was picked on the eighteenth day after the experiment commenced. From that time onward the samples were graded progressively through good middling, spotted, good middling grey, strict middling spotted, strict middling blue, strict low and strict low middling spotted, and finally became so low in colour that they could not be graded at all by the official colour standards.

215. VIRGINIA. *Experiments with Lime, Fertilizers, and Varieties of Field Crops in the Cotton and Peanut Section.* By E. T. Batten and T. B. Hutchinson. (*Virg. Sta. Bull.* 284, 1932. Abstr. from *Exp. Sta. Rec.*, lxvii., **6**, 1932, p. 668.) Results of fertilizer studies indicated that in a good rotation, including legumes, the entire fertilizer application for cotton should be made before planting, with about half of the nitrogen from organic and half from inorganic sources. Side dressings of an inorganic nitrogen and potash would be profitable on thin, light soils. Comparatively large quantities of potash appeared to be needed by cotton and peanuts, especially on light soils. From 1,500 to 1,800 lb. of ground limestone, or its equivalent, once in four years, was found to give best results in a rotation of cotton, corn, peanuts, and soybeans. For the crops included in the experiments, ground oyster shells and dolomitic limestone appeared of about equal value. In trials of crop varieties, the best varieties of cotton were Trice, Ingold, and Mexican, in the order named.

COTTON IN FOREIGN COUNTRIES.

216. Le Coton en Afrique Tropicale. By Paul E. A. Janssens (in collaboration with W. J. Lugard). (Pubd. R. Bausart, Bruxelles, 1932. Price: Belgium, 60 fr.; abroad, 14 belgas.) To those who can read French with ease, this should prove a useful book for general guidance when starting work upon a cotton plantation in tropical Africa. It commences with an account of the development of the flowers, of the fruit, and of the fibres upon the seeds, and this is followed by a good description of the kinds of soil best suited to the growth of cotton. Analyses are given of the soils in Belgian Congo and elsewhere in Africa, which go to show that, as is so often the case in the tropics, they are rather weak in nitrogen, potash, and phosphoric acid; but, on the other hand, cotton does not require so much of these as do some crops. Passing on to the cultivation of cotton (p. 32), it is noted that a better yield is obtained from land covered with secondary than with primary forest. A list of suggested rotations of crops is given (p. 42), and it is stated that the practice of rotation has produced not only a good crop of cotton, but so great an augmentation of food crops that famine is less to be feared than of old. The selection of seed (p. 52) and disinfection of seed (p. 76) are then dealt with, followed by sections devoted to cotton diseases (p. 83) and to cotton pests (p. 112). On p. 156 begins a long section dealing with the British African Colonies and Protectorates, and the charters and statutes of the British Cotton Growing Association and the Empire Cotton Growing Corporation are quoted in full. The colonies are taken one by one, and information is given regarding population, cotton legislation, experiments tried, varieties of cotton cultivated, climatic conditions, markets, experiment stations, rotations employed, crop yields, exports, diseases, pests, agricultural schools, staffs of Agricultural Departments, etc. Belgian Congo is described in greater detail (p. 231), followed by the French, Italian, and Portuguese colonies. The book is a useful one, but the arrangement of the matter into clearer chapters and the provision of a full index would have added to its usefulness. It is well furnished with illustrations, diagrams, and maps.

217. Belgian Congo. *Cotton Growing.* (*Cotton, M/c.* 7/1/33.) Information received is to the effect that it has been definitely decided to abandon the cultivation of cotton in the southern region of the Belgian Congo, including those districts of the Upper Uele which are too far from water transport. The crop of the colony will accordingly show a considerable decrease compared with recent years. The present yield is estimated at 9,000 tons. As soon, however, as certain narrow-gauge lines under construction are completed attempts will be made to grow cotton on a fairly large scale in new districts.

218. Brazil. *Cotton Cultivation.* (*Industria Text.*, i., **8**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **23**, 1932, p. 633.) The agricultural and climatic conditions of the cotton-growing states of Brazil are described, and the varieties of cotton and areas under cultivation are indicated.

219. *Cotton Cultivation.* (*Man. Guar. Coml.*, 10/12/32.) The potentialities of Brazil as a cotton-producer are discussed. In North Brazil the native tree cottons —Moco, Quebradinho, Inteiro, and Verdao—are produced; in the South, the "Herbacão" or American type is cultivated. Of the varieties, Moco is undoubtedly the best long-staple cotton in Brazil, with a long, silky, and strong fibre of $1\frac{3}{8}$ to $1\frac{1}{2}$ inches staple. Brazil has maintained an annual production of about 500,000 bales for many years, and most of it is consumed by the protected textile industry of the country. Labour is cheap and adequate for a crop of much larger dimensions than the present one.

220. *Cotton Cultivation.* By P. de Moraes Barros. (*Indus. Text.*, i., **8**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **24**, 1932, p. 675.) Large areas of the country are particularly suitable for cotton cultivation, yields being very high compared with those of other cotton-growing countries. Egyptian, American, and various indigenous varieties are grown. The characteristics of the indigenous types are described.

221. COTTON LANDS OF CENTRAL AMERICA. (*Man. Guar. Coml.*, 24/12/32.) Deals with the pests, irrigation, and labour problems of Mexico, Guatemala, and Salvador.

222. NEW COTTON ORGANIZATIONS FORMED IN CHINA. By T. M. Chang. (*Int. Cott. Bull.*, xi., **41**, 1932, p. 53.) Discusses the formation of the Chinese Cotton Improvement Association and the Chinese Cotton Statistics Association.

223. COTTON SPINNING IN KIANGSU PROVINCE. (*Int. Cott. Bull.*, xi., **42**, 1933, p. 256.) Indicates the progress made during the last fourteen years. In 1932 there were 1,580,744 yarn spindles and 110,544 thread spindles operating, as compared with 889,032 yarn spindles operating in 1919.

224. SHANGHAI. *Cotton Weaving and Knitting.* (*Text. Rec.*, L., **597**, 1932, p. 26.) A brief account, showing that, despite the general business depression, there has been considerable expansion in cotton weaving and knitting in Shanghai. The city offers many inducements for development on account of the ample supply of capital, labour, and transport facilities, and from supplementary household industries both weaving and knitting have become factory industries, using specialized machinery and methods for mass production. There are 5 large, 50 medium, and 40 small cotton weaving factories in Shanghai.

225. DUTCH EAST INDIES. *Cotton Cultivation.* By W. Spoon. (*Ber. Afdeeling Handelsmuseum Kon, Vereeniging Kolon. Inst.*, **73**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **24**, 1932, p. 675). A report on cotton cultivation by natives and by company enterprise. Native cultivation is carried on in Flores, and company cultivation in Flores, the South-Eastern Islands and Java. Samples of nine Dutch East Indian cottons have been examined by manufacturers; six appeared to be below the basic market value, while three types—a Sakel and a Zagora from Egypt, and a Sea Island from Surinam (Dutch Guiana)—were more favourably judged.

226. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No.* 9 contains the following articles: "Le coton en Cote d'Ivoire," by G. C. Gayral, with illustrations of the cottons cultivated in the 1931-32 season; "La culture du coton en Afrique du Nord en Septembre, 1932," by G. Carle; "La situation cotonnière en Russie Sovietique." The usual notes on cotton in the French Colonies, cotton legislation, etc., are included.

227. GERMANY. *State of the Cotton Industry.* By H. C. Strohmayer. (*Wirtschaftsdienst*, **17**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **23**, 1932, p. 672.) Employment, production, price and margin, and import and export figures for the German cotton industry are given, and the state of the industry in recent years is discussed. Tables showing the capital, reserves, profits, losses, dividends, etc., of the principal German cotton concerns for 1930-31 are also included and discussed.

228. ITALIAN COTTON INDUSTRY: CONDITION OF. By A. Tremelloni. (*Ind. Text. J.*, xlii., p. 405. Abstr. from *Summ. of Curr. Lit.*, xii., **22**, 1932, p. 632.) The Italian cotton industry uses 2 to 2·5 million quintals of raw cotton per annum, of which about three-fourths has been imported from the United States, less than one-fifth from India, and less than one-tenth from Egypt in recent years. The proportion supplied by Egypt has recently shown a tendency to increase,

while the shares supplied by the United States and India are declining. At the end of February, 1932, there were 5,523,254 spindles and 152,496 looms installed. Unemployment and the proportion of inactive machinery have increased since 1929. Production is turning towards articles of finer quality. Total consumption of raw cotton has declined from 1,037,957 bales in 1929 to 395,750 bales in the six months ended January, 1932. Cotton stocks, which in normal years amounted to 150,000 to 200,000 bales, advanced to 222,000 on February 1, 1932. As a result prices have declined. In 1928, India imported 2,488 quintals of cotton yarns worth 4,462,000 lire and 41,186 quintals of cloth worth 98,068,000 lire, from Italy. The corresponding figures for 1931 were 1,303 quintals of cotton yarns, worth 1,544,000 lire, and 15,000 quintals of cloth, worth about 27,000,000 lire. Further declines were shown for the figures for the first three months of 1932. A review of import and export figures shows that the cotton trade balance between Italy and India is largely favourable to India.

229. ITALIAN COTTON INDUSTRY: HOURS AND WAGES AGREEMENT. (*Boll. Cotonn.*, **27**, 1932, p. 479. Abstr. from *Summ. of Curr. Lit.*, xii., **23**, 1932, p. 672.) The national labour contract for the Italian cotton industry, signed at Rome on August 30 by representatives of the General Fascist Confederation of the Italian Industry and the National Confederation of the Fascist Syndicates of Industry, is given in full. The agreement is a national collective one affecting 250,000 cotton workers. The document contains forty separate clauses, together with a voluminous schedule of categories, wages, and conditions, relating to hours, overtime, and night work. The normal working week is forty-eight hours of effective work, based on the eight-hour day. The piecework rates are such that processes normally paid on a time basis are fixed so that an industrious worker of normal capacity shall earn at least 15 per cent. above time rates.

230. COTTON CULTIVATION IN NORTH AFRICA (CYRENAICA). By G. Piano. (*Boll. Cotonn.*, **27**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **23**, 1932, p. 633.) A report by the director of agricultural services for the Italian colony of Cyrenaica. The first tentative experiments were made under mission auspices with seed of the Caravonica Wood and Boyd's Prolific varieties in 1914. This work ended in 1918-19 with the cessation of the agricultural activities of the mission, but the discovery in 1926 of a magnificent cotton bush in the neighbourhood of the mission, and apparently left by it, led to a revival of interest. Seed from the plant, which was of the Caravonica Wood variety and had grown without irrigation, was sown, and in 1929 and 1930 samples of cotton were sent to the Milan Experiment Station for examination. The fibre was classed as Middling American, and the report was good. Parallel with these tests on the dry cultivation of cotton, some tests were made of cultivation under irrigation conditions. In 1926 and 1927 seed of the variety Abbondansia (*G. hirsutum*) was sown and gave good results, and in 1929 some Egyptian varieties were tried. Of these, Zagora gave the best results and Pilion the worst.

231. PERUVIAN COTTON: CULTIVATION. (*Man. Guar. Coml.*, **25**, 1932, p. 459. Abstr. from *Summ. of Curr. Lit.*, xii., **24**, 1932, p. 676.) In recent years cotton cultivation in Peru has progressed in the interior along the Amazon and its tributaries. The yield per acre is very high, reaching 800 lb. in many places, and rarely falling below 200 lb. The indigenous cotton plant, *G. peruvianum*, is a perennial shrub which produces a very rough, crinkly fibre, of a staple 1¼ to 1½ inches, when grown near the sea. The yield per acre is about 215 lb. The yield falls rapidly after the fifth year, and it is customary to replant every four or five years. About 3 per cent. of the indigenous growth yields coloured cottons. American Upland cotton was introduced into Peru during the American Civil

War. It is called "Egypto" or "suave" or "smooth." The plant grows to a height of 3 to 4 feet, and is cut down to within a few inches of the ground each season. There are two crops a year. Tanguis cotton was developed from a few plants which survived the blackroot disease of the late eighties of last century. The plant grows to a height of 6 feet, is fertilized with guano, and often yields four to five crops. Yields are as much as 800 lb. per acre. The long white fibre is of excellent quality and has a staple of $\frac{1}{16}\frac{5}{6}$ inch to $1\frac{3}{4}$ inches. Egyptian seed has been acclimatized in Peru and gives high yields. The total crop has grown from 55,000 in 1907-8 to 200,000 bales in 1929-30, with a maximum of 246,000 bales in 1926-27. About 80 per cent. of the exports are to Liverpool, the United States taking the remainder.

232. Taxes on Cotton in Peru. (*Man. Guar. Coml.*, 7/1/33.) In order to obtain additional funds for national defence, Peru has placed a new tax on her own cotton, both for export and consumption in the country. A tax of 75 centavos per quintal net weight is imposed on every class of ginned Peruvian cotton exported through the ports of the Republic from Lomas northwards, and a tax of 75 centavos per quintal net weight is imposed on ginned cotton of national production consumed in the country and produced in the coastal valleys. The new taxation is applied only to valleys from Lomas northwards, leaving those in the Department of Arequipa and farther south free. This is probably due to a desire to encourage the industry in the southern valleys.

233. Portugal. *Cotton Industry.* (*Int. Cot. Bull.*, xi., **41**, 1932, p. 128.) There are 146 mills with 550,000 spindles and 22,000 looms. The average consumption of raw cotton is about 16,000 tons, of which Angola and Mozambique provide together about 800 tons. The industry is said to employ 40,000 hands, with a wage bill of about £800,000, and supporting 100,000 families.

234. Russia. *Cotton Cultivation.* (*Man. Guar. Coml.*, 7/1/33.) Outlines the history of cotton cultivation in Russia since 1914, and discusses the working of the Five-Year Plan.

235. *Cotton Production.* By A. P. Demidov. (*Int. Cott. Bull.*, xi., 1932, p. 55.) Cotton production showed rapid progress during the period of 1929-31. The 1930-31 crop of 1,589,000 bales was the largest in the history of Russian cotton culture. Actual production, however, is less than 70 per cent. of the planned production. The author is of opinion that Soviet Russia will not be a serious competitor in raw cotton markets for many years, although disturbing sales may be prompted by internal financial necessity or conditions favourable for the exchange of Russian cotton for other growths or other needed raw materials. It is also considered that the vast and growing population of the country will require annually not only the finished products that may be turned out of her raw material, but those of a million, or even two million, bales from other countries as well.

236. Russian Textile Industry: Condition of. By H. A. Robiczek and R. Leonhardt. (*Ind. Text. J.*, xlii., 1932, p. 406. Abstr. from *Summ. of Curr. Lit.*, xii., **22**, 1932, p. 632.) The proposed development of the Russian textile industry has not been fully realized owing to lack of raw materials, but the mechanization of agriculture is proceeding rapidly, and the area given over to the cultivation of textile plants is increasing annually. According to the Five-Year Plan Russia's cotton yield should rise from 399·66 thousand tons in 1913 to 1,186·87 thousand tons in the season 1932-33. Statistics showing imports of textile machines, the value of machinery in operation, productions of textile goods, and imports of textiles into U.S.S.R. are given. The importance of Russian

raw materials in the world market, the danger of Russian dumping, and the need for international control are briefly discussed.

237. Results of Experiments with the Cotton Plant in 1929 at the Prikum Experiment Station. By I. P. Sarakhov. (*All-Union Sci. Res. Inst. Cott. Grow. and Cott. Ind. Tashkent*, 1931. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 64.) A collection of varieties was studied with special reference to earliness and yield, and observations were made on their development.

238. Cotton Lands of South America. (*Man. Guar. Coml.*, 17/12/32.) Discusses the possibilities of cotton production on a commercial scale in Argentina, Paraguay, and Colombia. The climate and soil of Argentina offer immense possibilities for cotton production, but shortage of labour, the competition of other crops, and the devastating effects of locust swarms retard rapid expansion. In Paraguay the Government and a Cotton Research Institute are aiding the development of the cotton industry by providing modern ginneries and presses, selected seed, and instruction. The quality of the cotton exported is favourably reported on by European users. The periodic visitations of locusts cause sharp setbacks, but otherwise the crop is comparatively free from pests. In Colombia cotton cultivation is hindered by labour shortage, but the country is capable of producing quantities of first-class cotton if the industry were properly organized.

SOILS AND MANURES.

239. Proceedings of a Conference of East African Soil Chemists. The Conference was held at the Agricultural Research Station, Amani, Tanganyika Territory, in May, 1932. The subjects under discussion were as follows: Proposed Soil Map of East Africa; Terminology in Naming and Classifying Soils; Analytical Methods; Soil Problems involved in "Shifting Cultivation."

240. List of Publications relating to Soils and Fertilizers. (List No. 16, Rothamsted Experimental Station, 1932.) An indispensable list of literature, with short abstracts.

241. Oxidation-Reduction Potentials and the Hydrogen-Ion Concentration of a Soil. By L. G. Willis. (*J. of Agr. Res.*, xlv., **9**, 1932, p. 571.) The oxidation-reduction potential of a soil characterized as naturally poorly drained, strongly acid, and high in organic matter varies inversely with the pH values produced by liming. A similar result is observed when the displaced solution from the limed soil is titrated with very dilute acid. Within the category of soils where this relation between oxidation-reduction potential and hydrogen-ion concentration holds, rates of liming must be gauged with reference to the possible effects of the increase in reductiveness of the soil at the higher pH values.

242. Mechanical Analysis of Lateritic Soils. By J. N. Chakraborty and A. Sen. (*Ind. J. of Agr. Sci.*, ii., **5**, 1932, p. 516.) *Summary.*—The following methods of mechanical analysis were tried on eighteen samples of lateritic soils from all parts of India: The International method without the peroxide treatment—HCl-NaOH; the Puri method—NaCl-NaOH; the Sudan method—Na_2CO_3. Since these lateritic soils were found to contain very little calcium carbonate and exchangeable bases, a direct NaOH method was tried, in which the soil was shaken directly with NaOH without the previous HCl or NaCl treatment as in (1) or (2) above.

The International, Sudan, and direct NaOH methods gave almost equal amounts of clay and silt in all cases. The Puri method, however, gave a lower clay figure for some of the soils. This was due to the insufficient quantity of alkali

used for dispersion, and lack of mechanical shaking in the method as prescribed by the author. Maximum dispersion of lateritic soils was found to take place in suspensions having pH about 10·5; consequently the quantity of NaOH to be used for dispersion should depend on this factor rather than on any arbitrary amount. In most cases 6 to 8 c.c. of *N* NaOH to 20 grms. of soil were found suitable for the purpose without being drastic. For lateritic soils containing more than 2 per cent. of organic matter, it is desirable to include the peroxide treatment. The direct NaOH method is found to be reliable and less laborious for the mechanical analysis of lateritic soils. A brief description of the method is given.

243. Saline and Alkaline Soils. By F. Hardy. (*Trop. Agriculture*, x., **2**, 1933, p. 35.) A summary of some results of recent researches on their origin, genesis, and agricultural relationships.

244. Determination of Nitrogen in Soils—I. By A. Srinivasan. (*Ind. J. of Agr. Sci.*, ii., **5**, 1932, p. 525.)

245. The Comparative Effects of Concentrated Nitrogenous Fertilizers on Permanent Soil Acidity. By F. E. Allison. (*J. Amer. Soc. Agron.*, xxiii., **11**, 1931. Abstr. from *Exp. Sta. Rec.*, 67, **6**, 1932, p. 658.) A theoretical discussion of the comparative effects of the addition of different concentrated nitrogenous fertilizers on permanent soil acidity, dealing chiefly with ammonia salts and nitrates. Suggestions are also given regarding the best methods of conducting experiments designed to show quantitatively the effect of fertilizers on soil acidity.

246. Experiments with Commercial Nitrogenous Fertilizers. By J. W. Tidmore and J. T. Williamson. (*Alabama Sta. Bull.* 238, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **1**, 1933, p. 25.) In studies as to the relative value of nitrogen sources on eight soil types, sodium nitrate produced more cotton for a five-year period on five of these types than other sources, while on the remaining three types ammonium sulphate was about as effective. The average relative efficiency on the eight soil series was sodium nitrate 100, ammonium sulphate 89, urea 86, a combination of Ammophos A and sodium nitrate 82, Leunasalpeter 82, and cottonseed meal 57.

The continued use of acid-forming nitrogenous fertilizers on unlimed land caused a reduced crop yield due to the development of soil acidity and a reduction in the amount of soil bases. In sandy soils the acidic fertilizers decreased the amount of exchangeable calcium and increased the amount of exchangeable hydrogen to an extent which was injurious to plant growth. The extent to which acid-forming fertilizers increased soil acidity varied with the soil and the chemical composition of the fertilizer, but relative values are given as ammonium sulphate 100, ammonium phosphate 100, Leunasalpeter 75, urea 50, and ammonium nitrate 50. Acidic nitrogenous fertilizers, when used on the same soil for a considerable period of years, caused a marked decrease in phosphate availability and an increase in water-soluble potassium.

Physiologically basic fertilizers caused an increase in phosphate availability and a reduction in the water-soluble potassium. Sodium nitrate was leached from a sandy and from a clay soil to a much greater extent than was ammonium sulphate. "Ammonium nitrogen was absorbed by cotton seedlings more rapidly than nitrate nitrogen."

247. The Relation of Nitrogen, Phosphorus, and Potassium to the Fruiting of Cotton. By H. Nelson and J. O. Ware. (*Arkansas Sta. Bull.* 273, 1932. Abstr. from *Exp. Sta. Rec.*, 67, **6**, 1932, p. 669.) The effects of nitrogen, phosphorus, and potassium upon the fruiting of cotton (Arkansas strains of

Rowden) were studied from 1927 to 1931 on Pulaski fine and very fine sandy loam at Scott. Varying quantities of each element—nitrogen in 50, 100, 150, 200, and 300 lb. of sodium nitrate per acre; phosphorus in 150, 300, 450, and 600 lb. of 16 per cent. superphosphate; and potassium in 20, 30, 60, and 80 lb. of potassium chloride—were used on trial plats, while in each case the other two elements were supplied in uniform quantities equal to those of the checks. The check plats received 500 lb. of 4-10-4 fertilizer per acre. In addition, each series included plats without fertilizer and plats supplied with only two elements.

The records of the development of fruiting parts showed that from the beginning of square formation in the nitrogen series, the numbers of squares were increased somewhat by phosphorus and potassium, without nitrogen. While the lighter applications of nitrogen increased square setting materially, the heavier applications did not cause further increases in numbers or rate of development. Like increases occurred in the blooming stage, with the greatest increases per unit of nitrogen coming from the lighter applications, although the heaviest nitrogen treatments produced the most blooms during the season. Shedding was in proportion to the number of blooms set and largely independent of the treatments. Seed cotton yields, like the number of bolls set, tended to increase from no treatment to the highest applications, although the greatest yield increase per unit of nitrogen resulted from the smallest application.

The average percentages of earliness did not increase with larger nitrogen applications, although the quantity of early cotton usually was larger from the heaviest treatment. The size of bolls was increased decidedly and the lint in 100 bolls slightly by the lightest application of nitrogen, but further increments showed no positive effects. The weights of seed, lint index, lint percentages, and the staple lengths were affected only slightly by the several treatments.

Nitrogen and potassium, without phosphorus, increased the setting of squares, the number of blooms, and the bolls set, and increased yields substantially, while the addition of phosphorus to nitrogen and potassium showed only slight effects. Shedding was in proportion to the total number of blooms developed, and the percentage of shedding after various treatments showed no definite trend. The lowest application of phosphorus seemed to increase the percentage of earliness, whereas further additions were ineffective. Phosphorus appeared to increase slightly the size of boll and the lint in 100 bolls, but did not affect weight of seed, lint index, lint percentage, and staple lengths.

Potassium seemed to increase very slightly the numbers of squares, blooms, and bolls. The shedding in the potassium series was more variable than in the nitrogen or phosphorus series, and the percentages were slightly higher. Potassium appeared to raise yields and percentages of earliness slightly, had no appreciable effect upon size of bolls, lint in 100 bolls, lint percentage, or staple length, and had a very slightly reducing effect, if any, upon the weight of seed and lint index.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

248. New Cotton Planting Machine. (*Wall Street Journal*, 15/12/32. New York.) A cotton planting machine which will plant seed at varying depths at regular spaces apart has been invented by John Randolph, an engineer of the Department of Agriculture, Washington. A public service patent has been obtained on the new machine, which has worked well in experiments, and its manufacture may be carried on without the payment of royalties.

249. Cultivation Machinery. We have received from Messrs. Ransomes, Sims and Jefferies, Ltd., a copy of their pamphlet "Ploughs and Implements for Mechanical Cultivation," containing good illustrations and descriptions of the

many ploughs, harrows, and cultivators manufactured by them. In addition, some interesting photographs are included, showing the tractor ploughs and other implements at work in various countries.

250. THE MECHANICAL HARVESTING OF COTTON. By H. P. Smith *et al.* (*Bull. No.* 452, *Texas Agr. Exp. Sta.*, 1932.) During the five years 1927 to 1931, inclusive, several types of cotton harvesters were devised and studied. The results secured with the Finger, Modified Finger, and Slot-Type machines were not satisfactory. They were inefficient and wasteful, as shown by the fact that it was possible to harvest an average of only 73·4 per cent. of the total yield of cotton in 1928 from twelve varieties tested. With the development of the Texas Station Cotton Harvester mounted on the side of a tractor equipped with smooth revolving rubber stripping rolls, it was possible in 1931 to harvest an average of 91·1 per cent. of the crop. Experiments showed that many varieties of cotton were not well suited for harvesting by machinery, and it was evident that a type of cotton with large storm-resistant bolls, a minimum of vegetative growth, and an early short fruiting period was necessary to get the highest efficiency from a mechanical harvester. Breeding work with a view to evolving a suitable cotton has made satisfactory progress.

Cotton harvested with the various types of mechanical harvesters was cleaned on special burr-extracting and cleaning equipment. Approximately 32·1 per cent. of trash was removed in the cleaning process, leaving 67·9 per cent. of cleaned seed cotton in which a small amount of trash remained. In ginning 4·7 per cent. of trash was removed. The machine-harvested cotton in 1931, after being cleaned and ginned, had the same staple length, and was only one-half grade lower than hand-picked cotton.

The cost of harvesting a bale of cotton with the one-row Texas Harvester amounted to $3.08 as compared with $15.75 for hand-snapping. The cleaning and ginning charges per bale for the former were $11.00, and for the latter $10.50. The slightly higher cost of cleaning and ginning mechanically harvested cotton is due to the fact that an average of 100 lb. more of this cotton is required to make a 500-lb. bale of lint. The total cost, therefore, of harvesting, cleaning, and ginning a bale of mechanically harvested cotton averaged $14.08, while a bale of hand-snapped cotton cost $26.25, showing a difference of $12.17 in favour of the former.

A complete list of the patents that have been granted on various types of cotton-harvesting equipment is given.

251. COTTON QUALITY AFFECTED IN GINNING PROCESS BY MOISTURE IN SEED COTTON. By F. L. Gerdes. (*U.S. Dpt. Agr. Yearbook*, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **1**, 1933, p. 38.) Compared with cotton ginned when green and damp, cotton ginned after artificial drying in driers developed by the U.S. Dept. of Agriculture had better quality and staple, the seed was cleaned more completely, and a better moting action was obtained during ginning.

252. COTTON GIN: RESEARCH ON. By C. Vincon. (*Cotton and Cotton Oil News*, xxxiii., **38**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **22**, 1932, p. 606.) A short discussion of the development of the gin, the use of mechanical driers, investigations of speeds and efficiencies, the effects of ginning on staple, the influence of moisture, and various other problems of ginning that are being studied at American laboratories and experiment stations.

253. COTTON GINS AND COTTONSEED-OIL MILLS: ELECTRIC DRIVING. By H. M. French. (*Melliand Text. Monthly*, 4, 1932, pp. 357 and 424. Abstr. from *Summ. of Curr. Lit.*, xii., **24**, 1932, p. 677.) The advantages of electric drives are discussed, and the different types of drives, motors, and controls in use are briefly described.

DISEASES, PESTS, AND INJURIES, AND THEIR CONTROL.

254. Insect Enemies of the Cotton Plant. By J. W. Folsom. (*U.S. Dpt. of Agr. Farmers' Bull. No.* 1688, 1932.) An illustrated description of the following among other pests of cotton in the Cotton Belt: Boll weevil, American bollworm, pink bollworm, cotton-leaf worm, cotton flea hopper, red spider, cotton stainer, army worm, cotton square borer, cotton-plant bug, tarnished plant bug, cutworms, etc. Various control measures are suggested, including: Dusting the insects with calcium arsenate or other dusts, planting of early maturing varieties of cotton, rotation of crops, growing of winter cover crops, early spring preparation of the land, and repeated cultivation during the season, ploughing under or burning of old cotton plants immediately after picking has ceased.

255. The Control of Cotton Pests by Mechanical Means. By D. D. Goloviznin *et al.* (In Russian.) (Moscow, OGIZ, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **11**, 1932, p. 625.) This handbook contains descriptions of fourteen dusting and spraying machines manufactured in countries outside the Russian Union that may be employed in the control of cotton pests in Central Asia, with instructions for using them, and notes on their working capacity, advantages, and disadvantages. It is based on the results of field tests with a large number of machines.

256. La Chloropicrina per la Distruzione del Parassiti nei semi di Cotone. By J. Levy. (*Boll. Reparto Fibre tessili R. Staz. sperim. Ind. Carta e Stud. Fibre tessili veg.*, iii., **2**, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **11**, 1932, p. 616.) A translation from the French of a paper by the author describing an apparatus for fumigating cotton-seed against insects, etc. The whole equipment is mounted on a cart and consists of a fumigation chamber, insulated to prevent loss of heat, and having a valve to admit chloropicrin from an outside container, a motor-driven suction fan, and a lamp for heating the interior of the chamber from 40° to 45° C. (104° to 113° F.), so as to shorten the time required for fumigation. The chamber contains gratings on which the seed is spread. The hot air, charged with chloropicrin vapour, is sucked from the bottom of the chamber and blown into the upper part, the current being broken up by several gratings. At the end of the operation the air is extracted from the chamber by means of the fan, which discharges it to some distance.

257. The Relation of Respiratory Metabolism of Insects to their Susceptibility to Fumigants. By R. T. Cotton. (*J. Econ. Ent.*, xxv., **5**, 1932, p. 1088.) The susceptibility of an insect to a fumigant varies with the rate of respiratory metabolism. Of the known factors that increase the susceptibility, the three most important are: An increase in temperature; an increase in the carbon dioxide content of the fumigation chamber; and a decrease in the oxygen content of the fumigation chamber.

258. The Chemical Composition of Commercially Available Fluorine Compounds. By R. H. Carter. (*J. Econ. Ent.*, xxv., **6**, 1932, p. 1224.) A survey of the chemical composition of the commercially available fluorine compounds was made. Fifty-seven samples of fifteen different materials were received from sixteen different sources. The percentage purity of these compounds in general was of a high order. The principal fluorine compounds that are now used as insecticides are sodium fluoride, sodium fluosilicate, barium fluosilicate, sodium fluoaluminate, potassium fluoaluminate, and "calcium fluosilicate compound." A few years ago some of these compounds were unavailable. Others were variable in composition, and their high density and other physical properties made them ill-suited for spraying and especially for dusting. At the present time, however,

pure fluorine compounds are available, and their physical properties have been improved by admixture of silica and in other ways so that they are quite satisfactory for spraying and dusting purposes.

259. QUEENSLAND. *Pests of Cotton in the Callide Valley.* By D. O. Atherton. (*Queens. Agr. J.*, xxxviii., **6**, 1932, p. 488.) Discusses the life history, nature of injury, importance of the pest, and natural enemies of the following: Corn-ear worm, cotton-leaf perforator, rough bollworm, and cotton looper.

260. SOUTH AFRICA. *Cotton Pests*, 1931-32. (*Farming in S. Afr.*, vii., **80**, 1932.) In connection with the loss of bolls through the bollworm (*Diparopsis castanea*) and other causes, further counts (200 plants throughout the season) yielded the following figures: Bollworm, 14·2 per cent.; natural shedding, 7·7 per cent.; partial damage by bollworm, 20 per cent.; sound bolls, 58·1 per cent.

The summer was characterized by a surprising expansion of the congregating phase of the brown locust (*Locusta pardalina*), which necessitated active control operations, at considerable cost, from September to May. As the result of scouting work, it was possible in most cases, and especially in autumn locust activities, to forecast active concentrations of solitaria (*congregans*), and to destroy the adults on the communal breeding-grounds. This method saved much labour and expenditure. Both arsenite of soda powder and arsenite of soda bait were used successfully against hoppers and adults. Considerable work was done in a search for less dangerous substitutes for arsenite of soda, and sodium fluoride, sodium fluosilicate, and calcium arsenate appeared suitable for baiting purposes. In connection with bait formulæ, it was found that dilution of sweetened liquid poison to 1 in 50 with water was not only efficacious, but that stronger concentrations were less attractive and tended to lump, and were, therefore, dangerous to stock. In addition to the brown locust, the Union was also invaded during the season by the redwing locust (*Nomadacris septemfasciata*), the migratory locust (*L. migratoria migratorioides*), and the desert locust (*Schistocerca gregaria*).

261. SUDAN. *Report of the Government Entomologist*, 1931. (*Wellcome Trop. Res. Labs. Bull. No.* 35, Ent. Section. 1932.) The work of the year was mainly concerned with the desert locust and the hairy-chested locust, and the control measures employed and the damage caused by these pests are discussed. At the Khartoum laboratory investigations were continued on the following: (*a*) The value of light traps as a means of control of the Sudan bollworm and other night-flying insects; (*b*) the possibility of maintaining and increasing the numbers of *Microbracon kirkpatricki*, a parasite of pink bollworm, and *M. brevicornis*, a parasite of a number of lepidopterous pests; (*c*) the influence of temperature and humidity on the bionomics of cotton stainers. Mr. J. W. Cowland, Entomologist in charge of the Gezira Entomological Section, reports that studies were continued on the leaf-curl disease of cotton and on the bionomics of the whitefly, *Bemisia gossypiperda*, the only known vector of this disease. The main facts of the life-history of the whitefly were ascertained, and some of the factors influencing its incidence indicated. The research work on two species of leaf-infesting thrips, which are serious pests of cotton in the Gezira in some years, was completed.

262. TANGANYIKA. *Cotton Pests*, 1931. (*Ann. Rpt. of Dpt. of Agr.*, 1931, recently received.) The chief pests encountered during the year were locusts, pink bollworm, spiny bollworm, jassids (among which a new variety was reported), whitefly, a Capsid (*Camptobrochis* sp.), the Sphingid moth (*Hippotion celerio*, L.), *Apion xanthostylum*, two Tettigonids: *Phaneroptera nana* and *Pœcilogramme striatifemur*. In addition to the above, much damage was caused by rats and field mice.

The Territory was twice invaded during the year by the migratory locust, *Locusta migratoria migratorioides*, the second invasion proving much more severe

than the first. Twelve insects predatory on hoppers are recorded. Adult locusts were found infested with red mites and a parasitic worm, *Mermis* sp. A tracheal mite, apparently one of the Tarsonemidæ, was located in the respiratory system of adult locusts, and blocking of the finer tracheæ was noted. Adult mites were found on the outside of the thoracic spiracles, so infection by contact is likely.

263. Boll Weevil in 1932. (*Int. Cott. Bull.*, xi., **42**, 1933, p. 192.) It is stated that weather conditions during the past summer and fall were generally favourable to rapid increase of the weevil population in most areas.

264. Studies of the Progress of Boll Weevil Infestation at Various Distances from Hibernation Quarters. By J. C. Gaines. (*J. Econ. Ent.*, xxv., **6**, 1932, p. 1181.) Gives the results of experiments planned to determine the relation between the progress of infestation in cotton at various distances away from hibernation quarters, and the flight of weevils as indicated by screen trap collections. The screen trap is described.

265. The Weed "Hambuk" (*Abutilon* spp.) and the Part it plays in the Conservation of Parasites of the Various Species of Bollworm which attack Cotton in the Sudan. By H. W. Bedford. (*Bull. Wellcome Trop. Res. Lab. Sudan Govt.*, Ent. Sect., 34, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A, **11**, 1932, p. 622.) Brief reference is made to an account of investigations in the Sudan on the relationships of pests of cotton and their parasites to weeds of the genus *Abutilon*. They are not attacked by *Platyedra gossypiella*, Saund., records of which from them are apparently due to misidentification, but as they are preferred food-plants of *Earias insulana*, Boisd., their destruction in the dead season for cotton has been regarded as desirable. If this were done, the weeds should still be encouraged to flower and fruit during the cotton season, as they will then attract most of the moths in preference to the cotton. Their destruction even in the dead season, however, would be attended by a great disadvantage in that they serve throughout the year as food-plants of *Crocidosema plebeiana*, Zell. This moth is an alternative host of *Microbracon kirkpatricki*, Wlkn., which is the most effective of the parasites of *P. gossypiella*. Observations in 1930 showed that *Crocidosema* is least abundant during April to June, a period that approximately coincides with the dead season, and in which the weeds flower and fruit little, particularly if deprived of irrigation water, but there is strong indication that as soon as the rainy season starts, both host and parasite increase in numbers, the latter, however, obtaining and maintaining the upper hand. It is very active on *Abutilon* from July for at least four months, a period in which the beginning of infestation of cotton by *Platyedra* occurs. To obtain early parasitism of the latter, an experiment is planned in which it is proposed to grow *Abutilon* during the dead season along the main irrigation canals bordering fields reserved for cotton. It is hoped that this will also favour the increase of various parasites of *E. insulana*.

[*Cf.* Abstr. **612**, Vol. VIII.]

266. Report on Cotton Insect and Disease Investigations. II. Notes on the American Bollworm (*Heliothis obsoleta*, Fabr.) of Cotton, and on its Parasite (*Microbracon brevicornis*, Wesm.). By J. S. Taylor. (*Sci. Bull. No.* **113**, *Dpt. of Agr. S. Afr.*, 1932.) The first part of the paper deals with the bionomics and control of *H. obsoleta* (variously designated American bollworm, Corn-ear worm, Tobacco-bud worm, Tomato worm or risper), which in some seasons causes damage to cotton in South Africa amounting to many thousands of pounds. All stages are described, and a list is included of the food plants of the pest. The results of biological, chemical, and mechanical control experiments conducted during the last ten years are summarized. The greatest measure of success appears to have been obtained with bait traps and spraying with Bordeaux mixture.

The second part of the paper deals with the life-history and distribution of the parasite *M. brevicornis*, which up to the present has only been recorded from the Barberton district in the Transvaal. It first appears early in September when the larvæ of *H. obsoleta* are present on plants of the genus *Antirrhinum*, and its numbers increase until mid-November, after which it gradually becomes less numerous, and disappears in January, the end of the flowering period of *Antirrhinum*. With only one exception, it has not been observed to attack *H. obsoleta* on plants of any other genus. The parasite has, however, been induced to oviposit on this host on cotton by placing tins containing flowering *Antirrhinum* in a cotton field and liberating a number of larvæ of *H. obsoleta* on the cotton plants, and a small number of adult parasites in the vicinity of the tins. Moreover, when confined on cotton bolls with larvæ of *Diparopsis castanea*, Hmps., it parasitized this species. Experiments to test the effect of cool storage showed that with a temperature varying from 40° to 56° F. pupæ could be kept in cold storage for various periods up to a maximum of twenty-eight days without suffering ill effects. The technique employed in breeding the parasite is discussed; *Euxoa segetum*, Schiff., proved the most satisfactory laboratory host.

Further work on *M. brevicornis* in connection with *H. obsoleta* has been discontinued for various reasons, which include the fact that it is difficult to rear under humid conditions, and the probability that humidity is also a limiting factor in the field.

267. Contribution to the Biology of the Spider Mite in the Tashkent Region. By — Tibilova. (In Russian.) (*Bull. Sci. Res. Inst. Cott. Cult.*, i., p. 49. Moscow, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **11**, 1932, p. 619.) Observations in northern Uzbekistan in 1930 on the red spider attacking cotton, which may be *Tetranychus telarius*, L. (*althææ*, v. Hanst.), or an allied species, showed that there are probably ten generations during the season of activity, which lasts from the first half of March till the beginning of October. The average incubation period varied from 4 to 8 days in July to 20 in October at 15·5° C. (59·9° F.), but in April, at a very little higher temperature—16·4° C. (61·52° F.)—it was only 8 days, which indicates that the development of the embryo partly depends on some factor other than temperature. In 4 to 5 hours after hatching, the larvæ begin to spin a very fine web. In summer the duration of the larva stage did not exceed 2 days, including the resting period. The nymphal stage lasted 2 days in June, 3 in July and August, 4 in April, May and September, and 28 in October. The deutonymph stage, which is passed by females only, lasted 2 days in June-August, 2½ in May, 8 in April, and 9 in September. Pairing takes place immediately after the deutonymph moults. The average period for oviposition was 25 days, with a maximum of 50, the bulk of the eggs being laid in June to August. The maximum number of eggs deposited by a female was 217. Unfertilized females laid eggs which gave rise to males only.

A list of the food plants of the mite is given. Experimentally it showed no preference for smooth or hairy leaves or for cotton as compared with other plants. Migration to cotton, which usually starts in June, is probably due to the drying up of the weeds or to the crowded condition of the mites. Infestation may be spread by their being transported on agricultural implements or carried by wind or by water during heavy rains. In tests in which over-wintered mites were submerged in water for varying periods, 67 per cent. survived for 20 hours and 22 per cent. for 78, 100 per cent. mortality only occurring after submergence for 100 hours. The summer generations proved to be more susceptible, 80 per cent. of the mites being killed after 9 hours and all after 10. It was also found that the mites may keep on the surface of the water for 24 hours.

The adults begin to enter hibernation in the first half of September. No

immature stages were found hibernating, with the exception of one batch of eggs on a dry leaf. Hibernation occurs under lumps of earth, dry leaves and stalks lying on the ground, or on weeds that remain green during the winter. No mites were present on cotton in the autumn after harvest. Apparently severe cold does not affect the mites; of those that hibernated in unsheltered places exposed to a frost of about −28° C. (−18·4° F.), 95 per cent. survived.

268. Data on the Biology and Ecology of the Cotton Mite, *Tetranychus* (*Epitetranychus*) *sp.* By Y. A. Piontkovskii. (In Russian). (*Nauchnoissled. Inst. Khlopkov.*, Moscow. 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **11**, 1932, p. 599.) A detailed account is given of the bionomics of the red spider that attacks cotton in Uzbekistan and Daghestan. The author considers the species concerned to be *Tetranychus* (*Epitetranychus*) *bimaculatus*, Harvey, which he regards as distinct from *T. telarius*, L. (*E. althææ*, v. Hanst.) The morphology of all stages is discussed in detail, with a list of the food plants. The number of generations observed in the field during the period of the activity of the mite was 17 in Uzbekistan and a maximum of 12 in Daghestan, the life-cycle being completed in a period that varied from 5 days in July at an average temperature of 27·7° C. (81·86° F.), and relative humidity of 59 per cent., to 26 days in April at 15·8° C. (60·44° F.) and 66 per cent. The incubation period varied from 3 to 19 days. The larval stage averaged 47 hours and the nymphal 78·5, more than half of these periods being spent by the larvæ and nymphs in a resting state when they suspend feeding. The maximum adult life of the females was 18 days and of the males 34. The number of eggs laid varied from 9 to 182. All the active stages are able to spin a web. Hibernation was observed in the adult stage only, the mites congregating in small groups on various weeds. The effect of temperature and relative humidity on the fertility of the mite is discussed at length; in Uzbekistan 56 to 65 per cent. humidity, combined with a temperature higher than 25° C. (77° F.) affords optimum conditions for breeding.

Besides the control measures already noticed, clean cultivation of cotton and the destruction of weeds are recommended for preventing infestation.

[*Cf.* Abstr. **252**, Vol. VI. of this review.]

269. *Heliothrips* Sp. affecting the Rain-grown American Cotton at Galaa el Nahl, Kassala Province. By W. P. L. Cameron. (*Bull. Wellcome Trop. Res. Lab. Sudan Govt.*, Ent. Sect., 34, 1931. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **11**, 1932, p. 622.) An account of experiments in the Sudan during 1930 on the effect of the date of sowing cotton on the degree of infestation by *Hercothrips* (*Heliothrips*) *fumipennis*, Bagn. and Cam., which of recent years has become a serious pest of cotton in Southern Kassala. The results indicated that if the cultivation of American cotton under rain conditions in this area is desired, the crop must be sown as early in the rainy season as possible, the most suitable period in most years being the last week in June or the first half of July.

270. Descriptions of two Species of *Hercothrips* Injurious to Cotton in the British Sudan. By R. S. Bagnall and W. P. L. Cameron. (*Ann. Mag. Nat. Hist.* (10), x., **58**, p. 412. London, 1932. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **11**, 1932, p. 620.) In researches on the cotton pests of the Sudan during the past few years, two of the species now described have been recorded under the name of *Hercothrips* (*Heliothrips*) *indicus*, Bagn., though neither is in fact referable to it. Descriptions are given of both sexes of the adults and larvæ of these two species (*H. fumipennis*, sp.n., and *H. sudanensis*, sp.n.), with a key to them and to *H. indicus*.

H. fumipennis (dark cotton-leaf thrips) is probably distributed throughout the northern Sudan. In the Gezira it attacks cotton during the first half of the growing season only, often doing very severe damage. It attacks American

cotton (Kassala Province) as well as Egyptian cotton (Gezira, Blue Nile Province, and Kassala Province) annually, and also occurs on *Dolichos lablab*, most varieties of beans, and many other plants. *H. sudanensis* (grey cotton-leaf thrips) is generally distributed throughout the northern Sudan. In the Gezira cotton is chiefly attacked during the latter half of the growing season, the outbreaks being more spasmodic than those of *H. fumipennis*, though when they occur the damage is severe. *Leucas urticifolia* is very attractive to this thrips, but *Dolichos* and beans are less so than to *H. fumipennis*.

271. The Locust Problem: Science Applied to its Solution. By B. P. Uvarov. (*Crown Colonist*, iii., **14**, 1933, p. 9.) Deals with the subject under the following heads: A change of species; salient points of the problem; what experience has taught; organization on international scale; what lack of finance may mean.

272. The Locust Problem in the Northern Caucasus: The Present Status and Future Prospects. By L. Z. Zakharov. (In Russian.) (*Bull. N. Caucas. Inst. Plant Prot.*, i. [viii.], No. 1. Rostov-on-Don, 1932. Abstr. in *Rev App. Ent.*, xxi., Ser. A., **1**, 1933, p. 30.)

273. The Phases of Locusts in South Africa. By J. C. Faure. (*Bull. Ent. Res.*, xxiii., **3**, 1932. Separately published, price 12s. Abstr. from *Rev. App. Ent.*, xx., Ser. A., **12**, 1932, p. 671.) A comprehensive paper dealing with the *gregaria* and *solitaria* phases of *Locusta pardalina*, Wlk., and *L. migratoria migratorioides*, R. and F., in South Africa. The previous invasions and geographical distribution of *L. pardalina* are discussed, with a map illustrating the range of invasions by its swarms, its permanent habitat (areas in which phase *solitaria* is always found), and the areas of incipient swarming. It was found that the eggs of this species will remain alive for thirty-seven months if kept dry.

274. Contribution a l'Etude des Acridiens Migrateurs du Soudan. By P. Coleno. (*Bull. Com. Etudes hist. sci. Afr. occid. franc.*, xiv., **3**, 1931. Abstr. from *Rev. App. Ent.*, xxi., Ser. A., **1**, 1933, p. 32.) Particulars are given of the migrations and breeding of the two species of locust *Schistocerca gregaria*, Forsk., and *Locusta migratoria migratorioides*, Rch. and Frm., in the French Sudan in the years 1928-31 inclusive, and the adults and hoppers are described.

275. Uberblick uber die Gesamtökologie der Afrikanischen Wanderheuschrecke *Schistocerca gregaria*, Forsk. (General Ecology of *S. gregaria*). By F. S. Bodenheimer. (*Biol. Zbl.*, lii., Pt. 9-10. Leipzig, 1932. Abstr. in *Rev. App. Ent.*, xxi., Ser. A., **1**, 1933, p. 11.)

276. Control of *Schistocerca* in Turkmenistan, U.S.S.R. (Report on Work done for the Control of the Migratory Locust). (In Russian.) By Y. M. Gal'pershtein and L. D. Moritz. (*Ser. nauch. Nauchno-issled. Inst. Khlopkovod. i khlop. Promuish.*, 7. Tashkent, 1930. Abstr. in *Rev. App. Ent.*, xxi., Ser. A., **1**, 1933, p. 31.)

277. Environmental Factors in Relation to Plant Disease and Injury: A Bibliography. By J. D. Wilson. (*Ohio Sta. Tech. Bull.* 9, 1932. Abstr. from *Exp. Sta. Rec.*, 67, **6**, 1932, p. 689.) A bibliography is given of more than 3,700 papers which make reference to the influence of environmental factors which are either directly or indirectly harmful to plants. The list is arranged alphabetically by the names of authors, and in separate sections references to the environmental factors are grouped. A host-disease-injury index is given.

278. Breeding for Disease Resistance at Dharwar. By G. L. Kottur. (*Curr. Sci.*, 1, p. 78, Mysore, 1932. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 46.) By selecting the few plants of Kumpta cotton which remained after a heavy attack of *Fusarium*, Dharwar 2 was evolved. Although 90 to 98 per cent.

resistant, it was wanting in respect to staple and other characters, and was therefore crossed with Dharwar 1. From this a resistant type desirable in every way has been produced, and is now under extensive cultivation.

279. The Influence of Environmental Conditions on the Development of the Angular Leafspot Disease of Cotton. IV. The Influence of Atmospheric Humidity on Infection. By R. H. Stoughton. (*Ann. App. Biol.*, xix., 1932, p. 370. Abstr. from *Rev. App. Mycol.*, xii., **1**, 1933, p. 22.) The results of the experiments described in this paper (which were made with the same material and on the same lines as in the previous work), showed that high atmospheric humidities, exceeding 85 per cent., favour the development of the angular leafspot disease (*Bacterium malvacearum*) of cotton. At humidities below 85 per cent. the degree of infection decreased rapidly. From a discussion of the relation of these results to those of the experiments on the influence of air temperature, the author concludes that the importance of humidity is mainly physical in nature, by affecting the time during which the droplets of moisture, allowing of the development of the bacteria, persist on the leaves of the host.

[*Cf.* Abstr. **202**, Vol. IX.]

280. Leaf-Curl in Cotton and Other Plants. By M. A. Husain. (*Nature*, cxxx., **3278**, p. 312, 1932. Abstr. from *Rev. App. Mycol.*, xi., **12**, 1932, p. 781.) The title of Mathur's recent communication "Leaf-curl of cotton in Garden Zinnias in North India" suggests that the virus causing leaf crinkle of cotton in the Sudan is identical with that responsible for a similar condition in zinnias at Dehra Dun, a fact that has not yet been established.

Leaf curl or crinkle is stated to be common in the Punjab on potato, tomato, chilli, cucurbits, and other plants, but so far no leaf crinkle has been found on cotton associated with *Bemisia gossypiperda*, although scarcely a leaf is free from whitefly infestation. Definite evidence as to the identity of the virus should be obtained in order to avoid confusion between crinkle in cotton and analogous conditions in other plants.

[*Cf.* Abstr. **107**, Vol. X.]

281. Seed Transmission of Cotton Wilt. By J. J. Taubenhaus and W. N. Ezekiel. (*Sci.*, N.S., lxxvi., **1959**, '932. Abstr. from *Rev. App. Mycol.*, xi., **11**, 1932, p. 713.) In 1930 cotton-seed of the Half and Half variety collected during the previous autumn in Texas, and known to be infected by wilt (*Fusarium vasinfectum*), was divided into two lots. The seed of one lot was planted in a series of forty cylinders sunk in the ground, tightly sealed at the bottoms and filled with sifted Norfolk fine sandy loam soil that had not been under cultivation for at least fifty years. Untreated seed from the infected plants was sown in wilt-free soil in twenty cylinders, while seed delinted with sulphuric acid and surface-sterilized with 1 in 1,000 mercuric chloride was sown in the other twenty. Plants in two of the cylinders of each lot developed typical *Fusarium* wilt, which attacked 3·3 per cent. of the total of 667 plants. On the other hand, not a single plant became wilted among the 723 raised from seed of normal Gorham Lonestar plants sown in the same soil in forty adjoining cylinders. In the second experiment with delinted and untreated seed, respectively, in two boxes, typical wilt developed in both, 2·2 per cent. of 644 plants contracting the disease, while no case of wilt occurred in a third box planted with seed from normal plants.

F. vasinfectum was recovered from all the wilted plants and successfully reinoculated into cotton seedlings. In 1929 and 1930 the fungus was isolated from only a small percentage of the seeds (2·2 and 4·6 respectively), but in 1931 the proportion of internally infected seeds was higher (23·7), the average for the three years being 5·9. In 1930 *F. vasinfectum* was recovered from the tap-roots,

main stems, peduncles, and some seeds from every boll of 9 of the 45 plants from which cultures were made. With the other 36 plants the fungus was obtained from the tap-roots, main stems, and peduncles, but not from the seeds. In 1931 the fungus was isolated from some of the seeds from all the bolls of 2 out of 8 plants.

282. Ozonium Root-Rot: A Problem of the Eradication of a Soil-infecting Fungus. By K. F. Kellerman. (*J. Econ. Ent.*, xxv., **3**, 1932. Abstr. from *Rev. App. Mycol.*, xi., **11**, 1932, p. 713.) The author states that an outbreak of *Ozonium* (*Phymatotrichum omnivorum*), the cotton root-rot fungus, discovered a few years ago in the grounds of the date palm experiment station at Indio, California (stated to be the most western point in which the disease has been hitherto recorded), was successfully suppressed by injecting the soil at a depth of 6 feet with a 1·25 per cent. solution of formalin at the rate of approximately 1 gallon of solution per cubic foot of soil. The apparatus used for the application is briefly described.

283. Cotton Root-Rot Disease. (*Rpt. of Chief of Bur. of Plant Industry*, 1931-32, U.S.A.) "The root-rot disease of cotton in Texas and other south-western States has been traced to a fungus that lives in the soil, beyond the reach of any treatments that have been applied to other plant diseases. A discovery that may open the way to practical measures of control has been made through a series of laboratory experiments in cultivating the fungus on artificial media, and testing its behaviour in relation to different sources of nitrogen. It was found that salts of ammonia had the effect of inhibiting the growth of the fungus, whereas good growth was obtained with other sources of nitrogen, such as calcium nitrate, potassium nitrate, and sodium nitrate. The toxic effect of ammonia on the root-rot fungus was confirmed in many subsequent experiments, including the disinfection of diseased cotton roots, by application of ammonia to the soil under field conditions. Further investigation is necessary to determine the possibility of developing a practical control of root rot."

284. Distribution of the Cotton Root-Rot Fungus in Soil and in Plant Tissues in Relation to Control by Disinfectants. By C. J. King and C. Hope. (*J. Agr. Res.*, xlv., **12**, 1932, p. 725.) In an attempt to fix the limits of an area infested with the cotton root-rot fungus, *Phymatotrichum omnivorum*, near Indio, California, methods were developed which served as guides in detecting the presence of the fungus even where no indicator plants were present. When conditions of moisture were favourable, conidial mats of the fungus formed in great abundance in open trenches that transected the infested area. Numerous trenches dug near the supposed margins of the infested area aided in locating the actual limits of the disease. In areas where the roots of susceptible plants were abundant, a fairly good idea of the limits of the disease was obtained by making numerous excavations throughout the area and inspecting the root fragments for the presence of the fungus. It was found that the roots of several large pistache trees (*Pistacia atlantica*) were infected, although the trees showed no symptoms of the disease above ground. Root-rot strands were found on the surface of some of the roots of large athel trees (*Tamarix aphylla*), but no injury to the roots was observed. In other species of Tamarix the roots showed extensive damage from the fungus, but the trees remained alive. It is evident that the root-rot fungus is able to exist in an active state for a long period on buried roots that remain in the soil after trees have died or have been removed. The root-rot mycelium that had penetrated into the inner tissues of large roots was protected for a long period from disinfectants that readily destroyed exposed strands and sclerotia. In attempting to eradicate the fungus from the area near Indio, a 1½ per cent. solution of formalin (commercial formaldehyde) was injected into the soil, by pressure

through ⅜-inch pipes, to a depth of 6 feet, at the rate of 1 gallon per cubic foot. To test the effectiveness of this treatment, pure cultures of the root-rot fungus growing on sterilized sections of fig, chinaberry, and pistache roots ⅜ to 1 inch in diameter were buried from 1 to 7 feet deep in the soil, and the formalin solution was applied over them in the usual way. A majority of the root specimens that were removed from the soil and tested during the first twelve days after the formaldehyde treatment showed a renewed growth of the fungus, but only 25 to 30 per cent. of those that remained in the soil twelve to thirty days showed further root-rot growth. In other tests root-rot inoculum was placed on the inside of steam-sterilized sections of fig and chinaberry roots 1½ to 2 inches in diameter and 3 inches long. These were sealed at one end and buried in the soil at depths of 1 to 7 feet immediately before the formaldehyde treatment was applied. When specimens were removed and examined thirty days after treatment, the inoculum in all the sections was alive, and in some specimens the mycelium had grown through the conducting vessels and partly covered the outside tissue. Examination of a large number of roots and root fragments removed from the formaldehyde-treated area, about ten months after the treatment, indicated that all the mycelium on the outside tissues was dead. In soil samples taken from the formaldehyde-treated area, about ten months after the treatment, seventy root-rot sclerotia were obtained; in other samples, taken twelve months after the treatment, 118 were obtained. All these were found to be dead. Root-rot sclerotia from a culture kept in the laboratory for two and a half years germinated and produced a vigorously growing mycelium. Laboratory tests showed that all parts of a root-rot sclerotium are capable of producing mycelium. Specimens from which the outer coats had been removed, fragments of the outer coat, and thin cross-sections of sclerotia, all produced mycelial growth. In order to facilitate the separation of sclerotia from the soil of infested areas a sieve made of ¼-inch mesh hardware cloth was placed over another sieve of 20-mesh screen wire. The soil was washed through them, leaving the coarsest soil and root material in the top sieve, and the sclerotia and some of the coarse material in the bottom sieve. In 1931 a small infested area in an alfalfa field near Coolidge, Arizona, and another on a Bermuda-grass lawn at Sacaton, Arizona, where a Chinese elm had been killed the previous year, were sampled with a posthole auger, and the sclerotia were separated from the soil by the washing process and counted. In the Coolidge area the sclerotia were most abundant at a depth of 6 to 24 inches, but four were found 48 to 54 inches below the surface. In the Sacaton area the sclerotia were more concentrated at various depths between 6 and 42 inches, but a few were found at a depth of 84 to 90 inches. It is apparent that the distribution of sclerotia is very uneven, both vertically and horizontally, in infested soils. In soil samples taken from nine borings in an area where a Chinese elm had died, 8,203 sclerotia were obtained. It was estimated that the total number of sclerotia in the soil comprising the root cone of the tree was more than a million. That most of the sclerotia were alive in an area that was known to have been infested for several months indicates that sclerotia under natural conditions do not soon lose their viability.

GENERAL BOTANY, BREEDING, ETC.

285. The Rise of Genetics. By T. H. Morgan. (*Amer. Nat.*, **66**, 1932, p. 560. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 48.) A masterly survey of the history of the science of cytogenetics from pre-Mendelian times.

286. Recent Advances in Plant Genetics. By F. W. Sansome and J. Philp. (J. and A. Churchill, London, 1932. Price 15s. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 80.) The volume under review is a summary of the

most recent developments and views on the phenomena of inheritance in the plant kingdom. As such it makes no claim to present the more familiar and elementary laws of Mendelian inheritance in the classic sense. The rôle of the chromosomes in inheritance is the theme of the opening remarks, and this gives the key to the whole work, which might almost equally be called a textbook of cytology; in fact, the two sciences have become so interwoven that it seems preferable to refer to them jointly as the science of cytogenetics.

Darlington's views on chromosome behaviour are adopted as they, in the opinion of the authors, fit the facts in the simplest and most satisfactory way. As the subject is of importance for a true understanding of the mechanism of inheritance, it is argued at some length, and evidence of a very cogent nature is presented in support of it, mainly in connection with the partial chiasmatype theory of crossing over.

An impressive body of evidence shows how the behaviour of the factors can be correlated with the behaviour not only of particular chromosomes, but of particular parts of the chromosomes. Just as the atom ceased to be the ultimate indivisible unit of matter, so the gene was apparently doomed to cede the title of unit of hereditary material, and we are assured in the third chapter that the gene is composed of numerous "elements" which, moreover, occupy different portions of the locus. It is evident that modern theories of the gene are becoming more and more quantitative in nature. The recent chromosome studies have been attended by signal success in elucidating genetical problems which have baffled geneticists for some time. The very cases which at one time constituted serious exceptions to the laws have now served to consolidate them and anticipate new ones. Perfectly good taxonomic species have been created artificially, and the question of the nature and origin of species, although not by any means solved, has assumed a very different and more clearly defined aspect as a result of the new knowledge. The material is highly specialized, and is not easy to present in readable sequence. In several places the account of results of other workers is given in such a way as not to be clear to the reader without reference to the original. There are various surprising omissions, especially of reference to important Russian work—for instance, Philiptchenko's views receive no mention in the discussion of "shift," nor do the recent cytological works of Levitsky. Imperfections are inevitable in a work of this nature, however, and no serious student of biology can afford to overlook this unique presentation of the results of the last few years in the field of cytogenetics as it relates to the plant kingdom.

287. Cotton-Breeding Today Works with Main Types known in Remote Past. By T. H. Kearney. (*Yearbook U.S. Dpt. Agr.*, 1930. Abstr. from *J. of Text. Inst.*, xxiii., **12**, 1932, A641.) A very brief historical account of selection in Sea Island and Egyptian, Upland, and Asiatic cottons, and of the methods of breeding. The necessity for isolation of the multiplication plots and for continuous roguing is emphasized.

288. Plant Immunity. (*Nature*, cxxix., **3268**, 1932. Abstr. from *Trop. Agriculture*, ix., **12**, 1932, p. 370.) A very interesting point of view has stimulated the investigations of Dr. A. C. Leeman into plant immunity (*Tent Bacteriologie*, Abt. II., Bd. 85). It is recognized that anti-body production and related phenomena, as they are associated with the animal body, play no direct part in the immunity of a plant. But it is shown that certain extracts and organic substances play a considerable part in stimulating the resistance of a plant to attack by a fungus disease. The substances when added to the soil are harmless to the parasite, but become detrimental when taken into a plant and incorporated with its protoplasm. Secretions and extracts of micro-organisms, and various enzymes,

have been found to reduce the damage caused by the parasitic fungus *Helminthosporium sativum*. The interaction of micro-organisms has also been studied as a means of disease control.

289. Memoirs of the Cotton Research Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The fourth number of Series A, Genetics, has recently been issued, and contains the following paper reprinted from the *Journal of Genetics*:

The Inheritance of Anthocyanin Pigmentation in Asiatic Cottons. By J. B. Hutchinson. A series of six multiple allelomorphs controlling the distribution of anthocyanin pigmentation has been demonstrated in Asiatic cottons. The symbols **R**, $\mathbf{R^1}$, $\mathbf{R^c}$, $\mathbf{R^r}$, r^o, and r^g are proposed for them. Red, the highest member of the series, has been shown to be dependent for its full expression on the presence of **Y**, the gene for yellow corolla. The presence in the **R** chromosome of genes affecting lint length and seed weight has been demonstrated. These genes have been shown to be responsible for only a small proportion of the variations observed in lint length and seed weight. The bearing of the distribution of anthocyanin genes and their modifiers on the classification of the cultivated Asiatic cottons has been discussed, and conclusions similar to those drawn in previous papers (Hutchinson, 1931, 1932) have been arrived at. The **R** series of multiple allelomorphs has been found to segregate independently of the **Y** series, and of **A**, one of the two complementary genes for "crumpled."

[*Cf.* Abstrs. **696**, Vol. VIII., and **476**, Vol. IX., of this Review.]

290. Inheritance of Lint Percentage in Cotton. By J. O. Ware. (*Journ. Amer. Soc. Agron.*, xxi., **9**, 1929. Abstr. from *Exp. Sta. Rec.*, lxvii., **1**, 1932, p. 25.) The inheritance of lint percentage in cotton was studied in four sets of crosses made at the Arkansas Experiment Station: (*a*) Pima (30·98 per cent.) × Winesap (31·91); (*b*) Pima (28·62) × Upright (36); (*c*) Winesap (30·69) × Sea Island (20·79); and (*d*) scant lint (5·55) × normal lint (34·31 per cent.). High lint percentage was shown to be incompletely dominant in the F_1 of the *d* crosses. In F_2 and in the progeny of the back-cross on the sparse-linted parent there was good evidence of a single factor control of lint percentage. The F_1 generation mean of the *c* cross also held an intergrade position between the two parental means, but in the *a* and *b* crosses it lay, respectively, below both of its parental means. Hence, high lint percentage was incompletely dominant in the *c* and *d* crosses, and low lint percentage was intensified in the *a* and *b* crosses.

291. Inheritance of Lint Colours in Upland Cotton. By J. O. Ware. *Jour. Amer. Soc. Agron.*, xxiv., 7, 1932. Abstr. from *Exp. Sta. Rec.*, lxviii., **1**, 1933, p. 33.) Crosses between strains of Upland Cotton, including I., Texas Rust (rust-coloured lint) × Hite (white lint); II., Algerian Brown (dingy brown) × Sproull (white); III., Nankeen (yellowish brown) × Rowden (white); and IV., Argentine Green (green) × Trice (white), were studied in several filial generations at the Arkansas Experiment Station.

Lint colour in the F_1 of each cross was an intergrade between that of the respective coloured and white parents, each of the four shades of the lint colour being incompletely dominant over white. In F_2 the respective crosses segregated into the coloured parental type, an intergrade coloured type identical with the F_1, and the white parental type. The parental types continued to breed true in subsequent generations, while the intergrade type split up, as did the F_1. It was evident that in Upland cotton each of the lint colours, rust, dingy brown, yellowish brown, and green is a distinct monohybrid character. Fine silky texture of lint, as found in cross IV., seemed to be completely linked with full green lint colour, and coarse lint appeared to be dominant over fine lint.

292. Observations Caryologiques sur Quelques *Gossypium*. By J. Szymanek and P. Gavaudan. (*C. R. Acad. Sci.*, **194**. Paris, 1932. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 64.) Crosses were made between *G. hirsutum*, varieties Hartsville and Allen, and *G. herbaceum*, varieties Karangani and Garohills. A few abnormal fruits were formed when Hartsville was used, and perfectly normal F_1 plants produced. The crosses with Allen were not successful. The characters of *G. herbaceum*, which was used as female, predominated, but the characters of the other species were observable in the bolls and lint quality.

Chromosome counts were made on the parents and hybrid, revealing 10 to 13 haploid chromosomes in *G. herbaceum*, 20 to 26 diploid in *G. hirsutum* Hartsville, 12 haploid in the F_1 hybrid. A self-fertilized line of Allen also showed 20 to 26 diploid chromosomes, as in Hartsville, whereas the unselected Allen had this number in the haploid stage, and as many as 50 in the somatic tissue.

293. Observations Caryologiques Supplémentaires sur Quelques *Gossypium*. By J. Szymanek. (*C. R. Acad. Sci.*, **194**, p. 1011. Paris, 1932. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 65.) Diploid chromosome numbers of 20 to 26 are given for Ishan (*G. vitifolium*), 18 to 22 for Baroncli, 20 to 26 for Koriba (*G. punctatum*), and about 20 for *G. arboreum-sanguineum*. The hybrids Ishan × Karangani (*G. herbaceum-indicum*) had 20 to 26, and Ishan × Saria (*G. punctatum*) 22 to 26. These results confirm the opinion of the authors, pronounced in the foregoing paper, of the existence of polyploidy within the *Gossypium* species. The *G. vitifolium* × *G. punctatum* hybrid is said to be more resistant to climatic changes, diseases, and pests, with lint sometimes better than the parents. The hybrids again resemble the female more than the male parent.

294. The Control of the Chromosomes by the Genotype, and its Bearing on some Evolutionary Problems. By C. D. Darlington. (*Amer. Nat.*, lxvi., 1932, p. 25. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 42.) A distinction is drawn between genetic and structural causes of difference in chromosome form and behaviour, and examples are given of cases where such differences appear to be genotypically determined. The relation of chromosome variation to such problems as the origin of meiosis, sexual dimorphism, and parthenogenesis is briefly indicated.

295. An Unusual Cotton Plant. By A. F. Kidder. (*Science*, lxxvi., 1932, p. 295. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 66.) A plant was observed in which twenty to fifteen fibres on each seed were $1\frac{3}{4}$ inches long, thus contrasting with the remaining fibres, which were $1\frac{1}{8}$ inches. The origin of the plant was traced back to a natural cross between a native Peruvian cotton and an American Upland.

296. A Note on a Floral Abnormality in Cotton. By M. Afzal and S. Singh. (*Agr. and Livestock in India*, ii., **6**, 1932, p. 634.) A "lintless" cotton plant was discovered in 1927 in a field of Mollisoni cotton near Sangla in the Sheikhupura district of the Punjab. It had a perfectly glabrous body, and the seeds had no lint or fuzz except for a small tuft of very short hairs at the chalazal end. Being devoid of lint and fuzz, the seed fell off from the capsules as soon as these dehisced.

Since its discovery the "lintless" plant has passed through four generations, during which it has bred true to all its characters, and it would appear, therefore, that it is a genuine mutant. It has been crossed with the normal Mollisoni plant, and a detailed study of the mode of inheritance of its different characters is under way.

The present note has been written to draw attention to a floral abnormality of the "lintless" plants. In the young stages the growth of the style is much quicker than that of the corolla, and the stigma therefore ruptures the tip of the bud, and

afterwards protrudes upwards, remaining exposed for some days before the flower opens. About three days previous to opening, however, the corolla grows much more rapidly and just covers the stigma; in the opened flower the stigma is not visible above the corolla. This abnormality of the flower bud renders selfing by the method of ringing and stitching impossible.

In the F_3 generation of a cross between this "lintless" plant and the ordinary Mollisoni, it has been observed that this abnormality is linked with glabrous plant body. The hairy plants of the F_2 generation have normal flower buds. The lintless plant is, therefore, a double mutant, and since there exists a complete linkage between lintlessness and this floral abnormality, it appears that the two mutant genes are situated very close to each other on the same chromosome.

297. On the Variation of Certain Characters of Cotton in Relation to the Position of Seeds in a Lock. By K. R. Sen and S. S. Iyer. (*Ind. J. of Agr. Sci.*, ii., **5**, 1932, p. 484.) The work was undertaken in order to determine the variations in the seed and the lint weights due to the position of the seed in the lock. The materials selected for the purpose were the well-opened bolls of the Punjab-American cottons—viz., Early Strain, 4F and 289F—picked at random in November, 1929, from different plants from the physiology plot of the Cotton Research Station, Lyallpur. A detailed investigation, involving the fibre length and fibre weight determinations, was carried out on the Early Strain alone. For the sake of comparison, the badly-opened bolls of all three cottons were also investigated with regard to the main problem.

The following conclusions are presented by the authors:

(1) The seed and the lint weights are, on the whole, correlated. The apical seeds give the lowest seed and lint weights. The seed and lint weights in the case of the basal seeds are also low.

From the experiments with the Early Strain it is evident that:

(2) The apical seeds give fibres of the least weight per unit length, the lowest ginning percentage, and the smallest number of hairs per seed.

(3) The fibre weight per unit length and the ginning percentage are high for the basal seeds.

(4) Average fibre length does not appear to vary with the seed positions.

(5) The present work is in accord with Turner's conclusions regarding the absence of correlation between the number of hairs per seed and either the ginning percentage or the seed weight.

The conclusions arrived at from the experiments with regard to the effect of position particularly on the seed weight, the lint weight, and the fibre weight per unit length have been tested by Fisher's method of analysis of variance. It has been found that the effect of position is significant in all the cases. This result definitely indicates that it is not enough to ascribe the differences in the values of any one of these characters for different positions of the seeds in a lock to random sampling alone, but that these differences must be due to some other cause.

298. The Influence of Period of Illumination on the Development of Cotton. By N. Konstantinov. (*Turkestan Plant Breed. Sta. Nihi. Pop. Sci. Ser.*, No. 10, 1930. From *Plant Breeding Abstracts*, iii., **2**, 1933, p. 65.) Experiments were carried out on perennial forms of *Gossypium peruvianum* and *G. herbaceum*, the effect of varying length of day being observed. The greatest acceleration of flowering was observed in the plants with ten-hour illumination. Various botanical forms and strains varying in earliness were subjected to this period of illumination. It was found that the reduced length of day had the most effect on the latest ripening types and less on the earlier ones. The very earliest reacted hardly at all to reduced light. The results of reducing the length of day are described in detail. The effects were produced by merely darkening the plant;

complete darkness was not essential. The importance of these results to the breeder in making hybridizations is pointed out, and it is suggested that it will be possible to cross forms widely differing in time of maturity. A cross which may be of advantage, for example, is that between the perennial Peruvian types, with extreme boll size, and the Egyptian cottons. The F_1 progeny of such a cross is actually under observation.

FIBRE, YARN, SPINNING, WEAVING, ETC.

299. Bale Sampling Machine. By H. Tobler. (*Text. Weekly*, **10**, 1932, p. 339. Abstr. from *J. of Text. Inst.*, xxiv., **1**, 1933, A57.) Illustrations are given of a device which will take a sample of cotton from the centre of a bale without necessitating opening up the bale or even the removal of the bands. The device is clamped to the bale, and a plunger is driven to the centre of the bale. The plunger is slightly conical, and a sample of cotton is retained on withdrawal. No heat is generated by the machine in the extraction of the sample. The advantages of the device are the speed in sampling and the possibility of taking the sample without the intervention of the human element, together with a minimum of waste. The weight of the sample extracted is 300 gm. instead of the conventional 500 gm., but this could be altered if desired.

300. Fibres: Fine Structure. By R. O. Herzog. (*Kolloid Z.*, **61**, 1932, p. 280. Abstr. from *Summ. of Curr. Lit.*, xiii., **2**, 1933, p. 35.) A plan of construction is devised for macro-molecules, and their origin and aggregation to bundles as in fibres are discussed. The most important problems of such systems are also approached. A scheme is given for arranging construction from the molecular to the histological scale. Figures taken from several publications give numerous examples of fibrous and laminar structure in interlaced substances, including cotton hairs.

301. Cotton Hair: Effect of Maturity on Properties. (*Trans. Centr. Asiatic Res. Inst. Cott. Growing, etc.*, "*Nihi*," 1931, No. 50. Abstr. from *Summ. of Curr. Lit.*, xii., **24**, 1932, p. 697.) A series of papers by various authors, as under, with an introduction and short summaries in English.

(1) *The Collection of the Samples and the Characteristics of the Materials Used.* By M. G. Rytikov. (pp. 7-14.) Details are given of the collection and characteristics of the samples. The varieties are Navrozky (Upland), Zagora (Egyptian), and Million Dollar (Asiatic).

(2) *Microscopic Study of Cotton Hairs of Different Degrees of Ripeness.* By A. P. Zakoshchikov et al. (Pp. 15-43.) This paper is mainly a description of the effects observed when cotton hairs of various ages from five to eighty days after flowering are examined under the microscope.

(3) *The Technological Properties of the Cotton Hair with Relation to the Degree of Ripeness.* By N. I. Marchenko. (pp. 44-56.) The contents of this paper can best be indicated by summarizing the tables that appear to be of interest. Table 1 analyzes cotton samples of eight stages of growth between thirty and eighty days, as follows: Clean fibre; natural defects, including dead cotton and diseased cotton; cleaning defects, including (*a*) ginning defects (further subdivided), and (*b*) cleaning faults due to the nature of the cotton (bearded neps and unripe seed); foreign matter; and waste. Table 2 shows how the staple varies with age. Table 3 refers to fineness, and Table 4 indicates how the proportions of ripe, not quite ripe, unripe, and dead hairs vary with age. Table 5 gives corresponding figures for strength and extension, and Table 6 for metric number.

(4) *The Chemical Composition of Cotton Hairs of Different Degrees of Ripeness.* By V. T. Ivanova and A. M. Kurennova. (pp. 57-71.) The cellulose content increases rapidly up to the fortieth day; beyond this there may be little further increase. Nitrogen content decreases until about the fiftieth day, after which it remains stationary. Phosphorus and pentosan contents decrease to about the fiftieth day, after which chemical composition is little different from that of fully ripe cotton.

(5) *The Ash Content of Cottons of Different Degrees of Ripeness.* By B. I. Ardeshev and B. I. Leonov. (pp. 72-80.) Table 1 reproduces previous results without relation to the age of the sample. Table 2 gives the following data for samples twenty-five to seventy days old—Ash, silica, sesquioxides (?), Mn_3O_4, CaO, MgO, MCl, NaCl. Table 3 quotes figures of Farghor and Probert for different varieties of cotton (ash, ash alkalinity, ash alkalinity per gram of ash). Table 4 summarizes the effect of age on alkalinity, alkalinity per gram of ash, and phosphorus content.

(6) *Chemical and Technological Tests on Cotton Samples of Different Degrees of Ripeness.* By G. A. Korjeniovski and E. Z. Plushkin. (pp. 81-100.) Deals with (*a*) scouring of cotton samples of different degrees of ripeness; (*b*) the hygroscopic properties of cotton fibres with relation to degree of ripeness; (*c*) effect of high temperature on the samples; (*d*) dyeing of samples.

(7) *Cotton Seed and Cotton Seed Oil with Relation to Ripeness.* By E. K. Lonsinger and R. L. Raskina. (pp. 101-111.) The usual analytical data are recorded. The conclusion is drawn that cotton seed may be extracted for oil after forty to forty-five days or expressed after fifty days.

302. Cotton Hair: Standardization of Units in Testing. (*Text. Mfr.*, **58**, 1932, p. 422. Abstr. from *Summ. of Curr. Lit.*, xii., **24**, 1932, p. 698.) The need for standardization of the methods and units used in the testing of cotton is discussed. Differences between the systems used by the Shirley Institute and by the Indian Central Cotton Committee are pointed out.

303. Cotton Linters: Viscosity in Cuprammonium Solution. By D. I. Galperin and D. I. Tumarkin. (*Chem. Abs.*, xxvi., **4947**, 1932. Abstr. from *Summ. of Curr. Lit.*, xii., **23**, 1932, p. 662.) Experimental results presented in graphs and tables show that viscosity of linters in cuprammonium solutions is the only important characteristic for all practical purposes. Other tests may become valuable only for very low grades of linters.

304. Raw Cotton: Magnesium Content. By A. Geake. (*J. of Text. Inst.*, xxiii., **11**, 1932, T279.) Tests indicated that all raw cottons contain magnesium in amounts equivalent to about 0·25 per cent. of magnesium chloride.

305. Examination of a Proposed Relationship between the Lea Test and the Single Thread Test Results. By V. Venkataraman and N. Ahmad. (*Tech. Bull. No.* 15, Ser. B., Ind. Cent. Cott. Comm., 1932.) *Summary.*—In the *Textile Weekly* of April 8, 1932, Gregson suggested a method of predicting the lea breaking strength of a yarn from an analysis of the individual results of its single thread test. As his conclusions were based upon the behaviour of only one yarn, it was not possible for him to infer either the general applicability or the limitations of his method. The present paper describes the results of application of Gregson's method, with the above-mentioned two objects, to 144 carded and combed yarns, spun from standard Indian cottons into counts ranging from 6's to 80's. The following conclusions are derived:

(1) The lea strength, as obtained by Gregson's method, is generally greater than the observed lea strength when the lea ratio

$$\frac{\text{lea strength (lb.)} \times 100}{160 \times \text{mean single thread strength (lb.)}}$$

is less than 70, and less than the observed lea strength when the lea ratio is greater than 70.

(2) The percentage differences between the calculated and the observed lea strength are comparatively small only if the lea ratio lies between 67 and 77. In almost all other cases the percentage differences are quite large, *i.e.* Gregson's method breaks down completely.

(3) Even when the lea ratio lies between 67 and 77 the agreement between the calculated and the observed lea strength is not always very good—discrepancy of 5 per cent. is quite common, of 10 per cent. not uncommon.

(4) There is apparently no relation between the counts and "lea ratio," so that unless a lea test is actually performed it is not possible to foretell the "lea ratio" of a yarn.

(5) In view of the above conclusions, the only practical application of Gregson's method is that, when both tests are performed, it can serve as a check upon the lea test results in those cases in which the lea ratio lies between 67 and 77. It cannot be used to predict the lea strength in any and every case.

(6) Even in the case of similar yarns, spun from duplicate lots of the same cotton, the percentage differences between the calculated and the observed lea strength may sometimes assume large values. This is probably due to the different degrees of irregularities in the structure of yarn which are revealed more minutely by the single thread test than by the lea test.

306. BALL-DRAG SHUTTLE. (*Man. Guar. Coml.*, 24/12/32.) Describes a new shuttle improvement invented by A. J. Slowe and J. W. Seward, of Burnley, which should be of great service to the weaving industry. The invention, which has been patented, takes the form of a ball-drag or ball-tension shuttle which is so made that ballooning, the bugbear of weaving managers, is reduced to a minimum, and cockled, rough, and uneven selvedges are prevented.

307. THE ANTI-CREASE PROCESS. (*Int. Cott. Bull.*, xi., **41**, 1932, p. 117.) In view of the great interest shown by the trade in the announcement that a creaseless finish had been discovered for cotton goods, Messrs. Tootal Broadhurst Lee Co., Ltd., have issued a memorandum on their new process. Although the word "creaseless" has appeared in the Press, this is not claimed by the company, as completely creaseless materials would not have the requisite textile properties. The new property is better described as a combination of resistance to and recovery from creasing. The process is based on the incorporation of synthetic resin in the textile material, and is a final process following on bleaching, dyeing, or printing.

The technical advantages of the process are:

(1) Woven and knitted fabrics of cellulose material can be made much more like wool or silk in their resistance to and recovery from creasing, without detracting from their draping qualities or handle.

(2) The dry strength of regenerated cellulose is increased.

(3) The wet strength of regenerated cellulose is greatly increased.

(4) The process increases the weight of the material by an average of 15 per cent.

(5) The tendency to slip is reduced.

(6) The laundry shrinkage is reduced.

(7) The extensibility of rayon material is greatly reduced, and this obviates many of the forms of distortion to which rayon fabrics are liable.

(8) In the case of fabrics composed of spun viscose, the individual cut fibres are more firmly held as a result of the anti-crease process.

TRADE, CO-OPERATION, ETC.

308. LANCASHIRE COTTON INDUSTRY: ECONOMICS. By E. M. Gray. (*Text. Weekly*, x., pp. 253, 333, and 491. Abstr. from *Summ. of Curr. Lit.*, xiii., **3**, 1933, p. 71.) The history of the depression in the Lancashire cotton industry is outlined, and its causes analysed with the help of relevant statistics.

309. RECOVERY IN THE INTERNATIONAL TEXTILE INDUSTRY. By Dr. A. Niemeyer. (*Text. Rec.*, L. **598**, 1933, p. 28.) An optimistic review of world conditions.

310. AFRICAN NATIVE CLOTHES: MARKET FOR. By W. F. Machin. (*Man. Guar. Coml.*, **25**, 1932, p. 437. Abstr. from *Summ. of Curr. Lit.*, xii., **24**, 1932, p. 714.) The author describes the various fashions in clothes observed in a journey on the direct north to south route from Cairo to Capetown and discusses the influences affecting habits of dress. He states that the African natives are interested in clothes, and will wear them as soon as money is in general circulation. The general development in clothes will be towards European standards, but in the meantime the textile trades would do well to study native fashions and encourage those that are likely to produce the greatest volume of trade.

311. NEW USES FOR COTTON. (*Text. Rec.*, L., **596**, 1932, p. 29.) Among the new uses demonstrated by the American Cotton Textile Institute are the following: cotton for houses, for packing farm and orchard products, for men's suits and hats, and for stationery.

312. NEW USES FOR COTTON. (*Int. Cott. Bull.*, xi., **41**, 1932, p. 136.) A new addition to the many thousands of uses for cotton in laminated form is the manufacture of bearings for machinery operating at high pressure. Roller bearings of cotton fabric compressed with other material, such as bakelite, are now produced in sizes ranging up to units large enough for service with shafting 12 inches in diameter. Bearings of this type are employed in machinery for rolling steel ingots. Among the advantages claimed for them are long service in heavy duty, and added economy due to the fact that they can be lubricated with water.

Other uses for laminated cotton are for safety helmets for miners and running boards for cars.

313. A BASIS FOR PROFIT IN COTTON MANUFACTURING. (*Text. Rec.*, L., **596**, 1932, p. 33.) In his address at the seventh annual meeting of the American Cotton Textile Institute, the president, Mr. G. A. Sloan, advocated balanced production, abolition of night work, uniform hours and co-operative effort, as the basis on which American cotton mills could be operated at a profit.

314. FIBRE AND FABRIC. (*Text. Rec.*, L., **596**, 1932, p. 35.) In the last of a series of broadcasting talks, under this title, Dr. Pickard, Director of the British Cotton Industry Research Station, Manchester, said that there were about 400 cotton cloths made more or less regularly in Lancashire which differed in structure and type. He also mentioned that pneumatic tyres had only become possible for many vehicles, such as motor-buses, because the newer knowledge of cotton allowed of the manufacture of the very strong canvas and cord required for these tyres. Investigation of these matters is yielding surprising and valuable technical results.

MISCELLANEOUS.

315. "Empire Journal of Experimental Agriculture." The Oxford University Press will publish in April the first number of this new quarterly journal, which, it is confidently believed, will meet the urgent need that exists of a journal for recording experimental work bearing on the improvement of agriculture throughout the Empire, but without trenching on the ground of existing journals of agricultural science or plant and animal pathology. The new journal will circulate throughout the British Empire, and will offer agricultural research workers a medium for disseminating the results of their investigations on the feeding and management of livestock, trials of farm machinery, cultivation and manuring of crops, etc., such research work having the first call on its space.

The journal will command a strong Editorial Board, including Sir John Russell, Director of the Rothamsted Experimental Station, as Chairman, Sir Rowland Biffen, Sir Daniel Hall, Sir Robert Greig, and Sir Frederick Keeble. Dr. E. H. Tripp, formerly joint-editor of the *Journal of the Society of Chemical Industry*, has been appointed Secretary and General Editor, and intending contributors should send their communications either to him at 40, Trowsbury Road, Sydenham, London, S.E. 26, or to a member of the Editorial Board.

The cost of a single number of the journal will be 7s. 6d. net, with an annual subscription (for four numbers) of 20s. post free.

We wish the new journal every success.

316. Skinner's Cotton Trade Directory of the World, 1932-1933. (London, Manchester, Bradford, New York, Montreal.) This is the tenth edition of this invaluable work of reference of the world's cotton industry. Substantial efforts have again been made to augment the information contained therein, whilst at the same time simplifying reference. In the latter connection, an Index is included of the names of all firms, companies, etc., contained in the directory, and this new feature will undoubtedly be welcomed and prove advantageous to the numerous users. The thumb-holes for easy reference to the various sections are labelled as follows: Contents; Index; Exporters, Merchants, etc.; Spinners, Manufacturers, and Doublers; Directors (British); Finishers, etc.; Fabrics; Silk and Rayon; Mill Supplies. All headings, indices, and explanatory notes are printed in English, French, German, Italian, Spanish and Portuguese. The customary revision of all details has been carried through, and valuable additions made to the particulars previously published. It is stated that whilst every endeavour is made each year to insure that the details given are as up to date as possible, the period taken for the book to go through the press precludes the insertion of a considerable volume of new data. With a view to surmounting this difficulty, information received too late for the directory will be found, from week to week, in the columns of the *Textile Weekly*, a companion publication. The directory is as indispensable as ever to all those in any way connected with the cotton industry. The price by post, inland and abroad, is 20s.; Canada and the United States, $7 (post and duty free).

317. The Cotton Industry and its Future. By K. Lee. (*Text. Rec.*, L., **599**, 1933, p. 24.) A survey of Lancashire's difficulties, and stressing the need of good leaders to help trade recovery, and the value of research.

318. Whither Lancashire? The Need for a New Outlook. By F. Gartside. (*Text. Rec.*, L., **598**, 1933, p. 41.)

319. The "Manchester School." The *Textile Recorder* in its issue of December last calls attention to this very useful semi-annual journal, published in the spring and autumn of each year. The present issue (vol. iii., No. 2) contains, among other interesting items, a narrative by Professor G. W. Daniels, describing

the balance sheets of three limited companies in the cotton industry. In lifting the veil of obscurity from his three companies, A. B, and C, Professor Daniels has provided the incentive for some quiet thinking and for comparisons of the past and present conditions. Further features of interest in the number relate to various aspects of economics. A discussion of the economic limits to expenditure on social services is contributed by Mr. Henry Clay, and Lord Melchett writes on the subject of "Is our Economic System Obsolete?"

320. STUDIES IN TROPICAL LAND TENURE. By H. M. Leake. (*Trop. Agriculture*, ix., **12**, 1932, p. 371, x., **1** and **2**, 1933, pp. 13 and 48.) Deals with the land tenure systems of Uganda, Nyasaland, Tanganyika, Gold Coast, Nigeria, Sierra Leone, and the Gambia.

321. EXPERIMENTAL DATA: THEORY OF ERRORS AND LEAST SQUARES. By H. Jeffreys. (*Proc. Roy. Soc. A.*, **138**, 1932, p. 48. Abstr. from *Summ. of Curr. Lit.*, xii., **23**, 1932, p. 672.) It is shown that where no previous knowledge of the probable degree of precision of a set of observations exists, the correct procedure is to assume that the probability of a value of h in the range dh is proportional to dh/h. The result is applied to the theory of least squares, with definite results. It is found that where the number of observations is small, the probability of error is more widely distributed than is given by the usual formula. In the extreme case of two observations and one unknown, the probable error of the mean is equal to the standard deviations.

ADDENDA.

322. RECENT ADVANCES IN AGRICULTURAL PLANT BREEDING. By H. Hunter and H. Martin Leake. With a Foreword by Sir Rowland Biffen, F.R.S. (J. and A. Churchill, London, 1933. Price 15s.). In this book an attempt has been made to present in a connected form the results of only such investigations as have advanced beyond the limits of purely academic interest, and the outcome of which has been the introduction of improved varieties into general agricultural use. Even adopting this restricted basis, the authors have found it impossible to include everything that is desired, but it is hoped that the accounts that appear will furnish ample illustrations of the general direction of progress, whilst they may also serve to indicate some of the many new problems that have emerged and await solution before further advance is made possible. The value of the book lies not only in showing concisely how, in a single generation, a surprising degree of control has been obtained over many of the important crop plants, but in the promise it holds out that the ingenuity of the plant-breeder may yet solve many of the pressing problems which confront those whose business it is either to raise them or handle them commercially.

Part I. deals with the crops of the temperate regions: wheat, barley, oats, flax, potato, forage grasses, clover, and root crops; Part II., with the crops of the sub tropical and tropical regions: coffee, cacao, tea, sugar cane, fruits, tobacco, opium poppy, tropical cereals, rubber, fibres, and oil plants.

In the section devoted to cotton (p. 294) a very useful analysis—based upon the work of Balls, Harland, Kearney, Leake, Mason, and others—is given of the various features that characterise the plant. The lines that breeding has followed are indicated, some of the successes obtained—such as U.4—are mentioned, and a useful list of literature concludes the section.

A subject and an author's index are included in the book, together with several good illustrations, and it should prove of much value to those interested in the advances of modern science.

323. WEST AFRICAN AGRICULTURE. By O. T. Faulkner and J. R. Mackie (Camb. Univ. Press, 1933. Price 8s. 6d. net). The authors state that this book

is written especially for candidates for Government service in West Africa, but they hope it may also prove interesting and useful to those who intend to go out to the country as missionaries. Their main object has been to deal with some of the problems connected with farming in West Africa, and to emphasize the methods by which it is attempted to solve these problems. The economic side of the subject has been particularly stressed.

The work commences with an admirable introductory chapter dealing with the various factors that exert great influence upon native agriculture, and which have to be carefully taken into account when such matters as the introduction of new crops, improved methods, etc., are under consideration. These questions are further expanded in chapters upon Political Economy, the Native Farm, Shifting (chena) Cultivation, and Mixed Farming. In Part II. more detailed particulars are given of the various crops cultivated, such as oil palm, cocoa, coconuts, rubber, cotton, groundnuts, ginger, cereal crops, root crops, and minor food crops. The general lines of the work on cotton—both in breeding and in cultivation and harvesting—are briefly described on p. 117. The book is eminently readable, and being accurate in its facts should prove of great value to all newcomers to West Africa.

324. AN INTRODUCTION TO TROPICAL SOILS. By P. Vageler. Translated by H. Greene (Macmillan and Co., London, 1933. Price 15s.). Review copy not received.

PERSONAL NOTES

We have to announce with much regret the death of two members of the Corporation:

Mr. William Howarth, who died at his home "Springlawn," Heaton, Bolton, on January 13. Mr. Howarth was a member of the Board of Trustees, Administrative Council, and Executive Committee of the Corporation.

Mr. Henry Roberts, whose death occurred on January 9 at his home "Addington," Smallshaw, Ashton-under-Lyne. Mr. Roberts was a member of the Administrative Council and the Executive Committee of the Corporation.

We offer our congratulations to Mr. L. Browett and Mr. M. D. Peterson, on the honours of C.B. and C.M.G. respectively, that have recently been conferred on them. Mr. Browett represents the Board of Trade, and Mr. Peterson the Foreign Office, on the Administrative Council and the Executive Committee of the Corporation.

We also tender our congratulations to Colonel J. J. Shute on his election as Member of Parliament for the Exchange Division of Liverpool. Colonel Shute is one of the representatives of the Liverpool Cotton Association on the Administrative Council of the Corporation, and is also a member of the Executive Committee.

APPOINTMENTS.

Mr. J. B. Hutchinson has resigned his post as Assistant Geneticist at the Cotton Research Station, Trinidad, to take up an appointment as Botanist and Geneticist at the Institute of Plant Industry, Indore. Mr. Hutchinson is due to arrive in England on May 15th.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually

brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

Gold Coast	Mr. J. Cook.
,, ,, ...	Mr. H. Nicholas.
,, ,, ...	Mr. J. M. Ward.
Kenya Colony	Mr. D. L. Blunt.
Northern Rhodesia	Captain J. Smith.
Tanganyika Territory	Mr. J. E. Bruce.
,, ,, ...	Mr. B. E. Eustace.
,, ,, ...	Mr. E. Harrison.
,, ,, ...	Mr. H. Marsland.
,, ,, ...	Mr. D. Sturdy.
,, ,, ...	Mr. A. Taylor.
,, ,, ...	Mr. N. H. Vicars-Harris.
Uganda	Mr. R. P. Davidson.
,, ...	Mr. N. S. Haig.
,, ...	Mr. G. H. E. Hopkins.
,, ...	Mr. H. L. G. Milne.
,, ...	Mr. E. A. Ruck.
,, ...	Mr. J. K. Shepherd.

The following officers of the Corporation's staff abroad are on leave in this country:

Nyasaland	Mr. S. T. Hoyle.
South Africa	Mr. W. L. Fielding.
Southern Rhodesia	Mr. A. N. Prentice.

Mr. C. H. Brown, who has recently left the service of the Egyptian Government to take up cotton selection work in Russia, has asked us to say that should any cotton workers wish to have Russian-acclimatized American or Egyptian seed, or new Russian selections, they may write to him at the following address: Soyuz Sovxoz Klopok, Markomzem, Moscow, U.S.S.R.

PRINTED IN GREAT BRITAIN BY
BILLING AND SONS LTD., GUILDFORD AND ESHER

THE
EMPIRE COTTON GROWING
REVIEW

VOL. X. JULY, 1933. NO. 3

THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

BY

SIR ALGERNON ASPINALL, C.M.G., C.B.E., B.A.
Secretary of the Tropical Agricultural College Committee.

To Sir Norman Lamont, the second baronet, is due the credit for having been the first to call attention to the need of an Agricultural College for the Colonies situated within the tropics.

In an article which appeared in the *Empire Review* as far back as 1902 he, then Mr. Lamont, sketched out the form which such a College might assume.* Read today, his suggestions seem to have been almost prophetic. He considered that the Imperial Department of Agriculture, which had been founded by Mr. Joseph Chamberlain four years before, would form " an excellent nucleus for the College," which must be of university standing; that candidates for admission, who should not be less than seventeen years of age, should be required to pass a searching examination before admission and again at the close of each year's session, which should be of nine months' duration; and that there should be attached to the College an instructional sugar factory—all of which has come to pass. Developing his theme in 1913 at a meeting held under the auspices of the Liberal Colonial Club at the residence of Sir Robert Perks, M.P., he definitely suggested that the College should be in Trinidad and that the headquarters of the Imperial Department should be transferred to that island. He also stressed the great importance of research.

Another protagonist of the movement was Professor J. B. (now Sir John) Farmer, who declared in season and out of season that the College must not be a mere local institution, but must have a real scientific and research outlook and very high ideals.

* " The West Indies: A Warning and a Way," by Norman Lamont. *The Empire Review*, vol. iv., No. 19, August, 1902.

It was not until after the War that the proposals for the establishment of a Tropical Agricultural College emerged from the discussion stage. Sir Francis Watts has already related in these pages how in accordance with the recommendations of a Committee set up in 1919 by Viscount Milner, then Secretary of State for the Colonies, with that eminent biologist and man of affairs Sir Arthur Shipley as Chairman, the West Indian Agricultural College was founded in Trinidad in 1921 and was thrown open to students in the following year.*

Pending the presentation of a petition to the King for a Royal Charter, the College was incorporated as a company "limited by guarantee." Sir Arthur Shipley was Chairman and Sir David Prain, then still the Director of the Royal Botanic Gardens, Kew, Vice-Chairman. Sir Francis Watts, the Commissioner of Agriculture for the West Indies, was the first Principal, and he and the members of his scientific staff who, with the headquarters of the Imperial Department of Agriculture, were transferred from Barbados to Trinidad, formed the Academic Board.

In selecting Trinidad as the site of the College the Tropical Agricultural College Committee were influenced by several advantages offered by that island. Foremost among these were complete immunity from hurricanes or cyclones, a wide variety of tropical products, and accessibility from the other West Indian islands and British Guiana as well as from England. There were also Trinidad's generous offers of land at St. Augustine, and a handsome contribution of £50,000 for building, to provide which the planters actually asked that they might be taxed. It should be recorded that, after the Committee had approved their Report, Jamaica made a similar offer conditional upon the Imperial Department being removed to that island.†

It is still sometimes asked why the College was located in the West Indies and why not in Ceylon or Malaya, for example. The reply is that, as Lord Milner and Sir Arthur Shipley used to say, the College *had* to be placed *somewhere*, and experience has shown that its geographical position has not deterred students from entering it from Ceylon and even the distant Seychelles.

Prince Albert Victor and Prince George, now King George V., in their narrative of their cruise in H.M.S. *Bacchante* (1879-1882), after

* "The Imperial College of Tropical Agriculture," by Sir Francis Watts. *The Empire Cotton Growing Review*, vol. i, No. 1, January, 1924.

† Report of the Tropical Agricultural College Committee, presented to Parliament by command of His Majesty, February 1920. Command 562.

describing a visit they paid to the Maracas Fall in Trinidad, wrote: " On returning the views appeared finer than they did on going up. . . . Just above San Josef . . . from the front of the Church . . . the plain looked in the low evening sunlight just like an English park with its grass, and large rounded trees standing here and there in the paddocks." Just over forty years later that park-like plain was selected by Mr. W. G. Freeman, then Director of Agriculture of Trinidad and Tobago, as the ideal site for the new College. On it have now risen residences, hostels, and laboratories grouped round about a stately building which accommodates the administration department and the library, while unobtrusively tucked away in one corner are the sugar factory, power house, gas plant, and low temperature station. The Principal occupies the old " great-house" of St. Augustine estate, and scrupulous care has been taken to preserve the amenities of the site. The condition of the buildings, roads, lawns, and hedges is an object lesson of how real estate should be tended in the tropics.

Although the College began its existence as a West Indian institution, provision was made at the very outset for post-graduate study and research, and " refresher " courses for Agricultural Officers, besides a three years' Diploma course. The Governing Body in their first Report declared that they had had constantly in view the desirability of establishing the College on the broadest Imperial basis so that it might provide for the needs not only of the British West Indian Colonies and British Guiana, but also of the tropical Colonies of the Empire generally. In 1923, in order to emphasize the Imperial nature of the undertaking, they changed the name of the College to " The Imperial College of Tropical Agriculture." Under that significant title it was incorporated by Royal Charter in 1926, receiving in the following year the gracious patronage of the King.

Meanwhile Sir Francis Watts, who had done so much toward founding the College, had retired in 1924 and had been succeeded by Dr. Hugh Martin Leake, Principal of the Agricultural College at Cawnpore, whose régime was marked by much valuable constructive work, including the planning of roads and additional buildings and an expansion of the curriculum.

In the first academic year there were eleven Diploma students and two post-graduates on the register. At the close of 1924 the corresponding numbers were eighteen and fourteen. They have since steadily increased, until this year there were fifty-two students in residence, of whom twenty-four were taking the Diploma course, twenty-five the post-graduate course, and three special courses.

A turning-point in the history of the College was the appointment of a Committee in 1924 by Mr. J. H. Thomas, M.P., then Secretary of State for the Colonies, with Viscount Milner as Chairman, to enquire into and report upon the recruitment and the training of officers for the Agricultural Departments of the non-self-governing Dependencies. Since the War there had been a definite awakening to the potentialities of the Colonies, with their area of upwards of 2,000,000 square miles and their vast population of 50,000,000 souls, as a source of supply of essential foodstuffs and raw materials, and as a market for manufactured goods. Between 1905 and 1925 trade between the United Kingdom and the Colonies had been nearly quadrupled, but for the further development of agriculture scientific assistance was lacking, and there was grave difficulty in finding suitable candidates for the Colonial agricultural services.

Recognizing at once the seriousness of the shortage of botanists, entomologists, and mycologists, the Committee presented to the Secretary of State for the Colonies in March, 1925, a preliminary report in which they outlined a scheme for the provision of post-graduate scholarships to be granted annually to suitable applicants in order to create a pool from which the needs of the various Colonial Agricultural Departments might be met from year to year.* They recommended that these scholarships should normally be granted for two years, the first to be spent at institutions in this country and the second usually at the Imperial College of Tropical Agriculture, in order to give the scholars a practical introduction to systems of tropical agriculture on the spot.

These recommendations were approved by a great majority of the Colonial Governments invited to co-operate, and the Imperial Government consented to provide, over an experimental period of ten years, grants equivalent to one-third of the total contributions available. It is noteworthy, and indeed an historic fact, that in adopting this system the Government was following the lead of the Empire Cotton Growing Corporation, which, having similarly experienced difficulty in recruiting suitable officers for its research and development work, first sent out selected candidates for training at the Imperial College of Tropical Agriculture in 1922. Fifty-five students of the Corporation have already passed through the College and are now working in such widely scattered parts of the Empire as the Union of South Africa, Northern Rhodesia, Southern Rhodesia, Nyasaland, Uganda, Nigeria,

* Embodied in: Agricultural Research and Administration in Non-Self-Governing Dependencies. Report of a Committee appointed by the Secretary of State for the Colonies, Command Paper 2825. 1927.

the Gold Coast, the Sudan, Tanganyika, Trinidad, Jamaica and Ceylon.

It was not until three years later that the first Colonial Office students entered the College. No fewer than 120 have now passed through it and most of them have taken up appointments in the Colonial agricultural services. Never before can the report of a Committee have been more promptly or successfully implemented.

Since the Cotton Research Station was opened by the Empire Cotton Growing Corporation in 1926 it has been closely associated with the College. Dr. S. C. Harland and Mr. T. G. Mason, its two executive officers, had been for a short time members of the College Staff. Its research laboratories are within a stone's throw of those of St. Augustine and are provided with gas and electricity from the College plant. The liaison became closer in 1927, when on Dr. Leake's retirement Mr. Geoffrey Evans, who had been Director of Cotton Culture in Queensland under the Corporation since 1923, was appointed Principal, and, after the lamented passing of Sir Arthur Shipley, whose last illness was undoubtedly aggravated by anxiety and worry over the finances of the College, Sir James Currie, Director of the Corporation, became Chairman of the Governing Body of the Imperial College.

All that is necessary in respect of investigations into cotton is performed at the Cotton Research Station, and long-range research at the College is confined to cacao, sugar-cane, bananas, and citrus. Cacao research is financed by some of the leading manufacturers and the cacao-growing Colonies, and, for the present at any rate, banana research by the Empire Marketing Board, which provided funds for the erection and equipment of a modern low temperature plant. Side by side with this research, experiment work is being carried on with soils and fertilizers with the support of Imperial Chemical Industries, and each of the principal departments of the College—namely, those devoted to agriculture, botany and genetics, chemistry and soil science, economics, entomology, and mycology and bacteriology—is conscientiously working on various problems with the solution of which they are concerned. Each with one exception is under the charge of a professor (in the case of entomology a senior lecturer), who is assisted by a lecturer. Mention must also be made of the Department of Sanitation and Hygiene, the officer in charge of which imparts to the students a rudimentary knowledge of health in the tropics which not only proves of great value to the men themselves but also to the labourers under their control in the various parts of the world in which they are posted.

As Professor, now Sir John, Farmer has pointed out, there had existed a gap, largely unbridged, between the university at home and the work that awaited the agricultural officer in his district, where the conditions that embraced his problems and affected their solution were so widely different from those within the range of his previous experience. The College enables this hiatus to be short-circuited, and it is now possible for a man in a few months to build effectively on his previous knowledge of principles. In short, he is now in a position to obtain easily and under exceptionally favourable conditions just that kind of wide outlook over, and reasonably intimate familiarity with, the material and environment of his prospective problems so necessary for ultimately attacking them with good prospects of success. Then, to quote Sir Arthur Shipley, men of science are slowly but surely gaining control over the devastating forces of nature. To train them for the conquest they must have education. They must be taught what advances have been made by their predecessors, and what advances are being made by their contemporaries. Above all they must learn to observe accurately and to record faithfully what they have observed. Such training cannot be carried out at home and alone. It needs an institution like the Imperial College with its library, its laboratories, its experiment fields, and its staff of skilled professors and lecturers.

The College was visited by Mr. F. L. Engledow, now Drapers' Professor of Agriculture at Cambridge University, in 1929, at the request of the Empire Marketing Board, and in 1932 by Mr. F. A. Stockdale, the Agricultural Adviser to the Secretary of State for the Colonies. Both were favourably impressed by what they saw, and the College received also the commendation of the Colonial Office Conference which met in London in 1930. A Committee of the Conference, of which Sir Herbert Stanley, then Governor of Ceylon, was Chairman, recorded their deep appreciation of the work being carried out, and placed on record their recognition of the importance of the Imperial College as the centre for post-graduate training in tropical agriculture for the agricultural services of the Colonial Empire. In their report on the organization of a unified Colonial Agricultural Service they recommended that membership of the service should be confined in future to candidates who had received not less than two years' training, of which in the case of Colonial Agricultural Scholars one year would normally be spent in Trinidad. It is a matter for regret that, owing to circumstances arising from the world trade depression, the unified Colonial Agricultural Service, which had also been so strongly advocated in 1927 by the Committee of which the late Lord

Lovat was Chairman, has so far failed to materialize; but when the proposals in this connection are revived the Imperial College should be in a position to play its part in making them effective.* To revert to the Committee of the Conference. They finally expressed the hope that every Government might find it possible to give substantial financial assistance to the College and that " in any instance where circumstances should preclude this being done, at the very least an annual contribution of a nominal amount will be forthcoming in recognition of the importance of the College in the development of Colonial Agriculture." Approval of the Committee's report was recorded by the Conference at a plenary meeting held in 1930, in the following minute: " In particular the Conference recognizes the importance of the Imperial College of Tropical Agriculture as the centre for post-graduate training in tropical agriculture for the Agricultural Services of the Colonial Empire. It recommends that those Colonial Governments which do not at present contribute towards its maintenance should be invited to give some financial assistance to the College as soon as a reliable forecast can be given as to its needs for the next five years." Then came the economic depression, and so acute was the financial crisis that the Colonial Office declined to invite the non-contributing Colonies to make even token contributions towards the maintenance of the College, whose staff is so ceaselessly working in the interests of the tropical parts of the Empire.

The question of finance has been a constant source of anxiety to the Governing Body. At the start contributions of one-half of one per cent. of their revenue made by the West Indian Colonies (Jamaica excepted) towards the cost of maintenance were supplemented by a grant-in-aid of £15,000, spread over five years, from His Majesty's Government. The British Cotton Growing Association contributed £500 in the first year and has given the same amount annually ever since. In the second year the Empire Cotton Growing Corporation made the first of a series of annual grants of £500 which are still being maintained, and in 1926 it generously contributed jointly with the Empire Marketing Board and in equal moieties a capital sum of £42,000, of which £10,000 was earmarked to meet existing liabilities and the balance for new buildings and equipment. This brought the total of a special fund which Viscount Milner, and after his death Viscount Burnham, consented to raise to £87,872. The Empire Marketing Board has also been a generous benefactor of the College. From 1926-27 onwards it provided annual contributions at first to

* Colonial Agricultural Service. Report of a Committee appointed by the Secretary of State for the Colonies, Command Paper 3049. 1928.

meet deficiencies and latterly in the form of block grants, but with increasing demands made upon the College, and the rapid development of its activities, the Governing Body found it impossible to balance the annual budget. In 1931 they were promised a block grant of £16,000 a year for five years from the Empire Marketing Fund, but when the world trade depression became acute the grant was cut to £14,400 and the prospect of its continuance appeared doubtful. A deputation, therefore, waited on Sir Philip Cunliffe-Lister on December 10, 1931, to explain to him the gravity of the situation. It was introduced by the Earl of Derby and included representatives of Cambridge University, the Empire Cotton Growing Corporation and the British Cotton Growing Association, besides the Governing Body, who declared that the difficulty of financing the College had become so acute as to threaten to interfere with the education and research proceeding at it. As a result the Empire Marketing Board undertook to provide an annual block maintenance grant of not less than £14,400 and not more than £16,000, according to the strength of its financial position, for each of the four years 1933 to 1936. But now the Empire Marketing Board has been thrown into the melting pot. The uncertainty is therefore greater than ever, and it can never be completely removed until the Imperial College of Tropical Agriculture has behind it a substantial endowment fund, for the creation of which there is pressing need. In 1932 the Governing Body received a welcome contribution of £32,000 towards such a fund from the Carnegie Corporation, and it will be a sad reflection on British enterprise if it is not supplemented by similar gifts from wealthy firms and individuals resident in this country and in the Dominions and Colonies, whose imagination must surely be stirred by the achievements of the College, past students of which are now promoting the development of agriculture on scientific lines throughout our far-flung Empire.

Received June, 1933.

THE CASE FOR CHARTERED COMPANIES

BY

H. MARTIN LEAKE, M.A., Sc.D.

THE title which appears at the head of this article is not original; it is unblushingly appropriated from an address delivered at a meeting of the Royal Empire Society by Sir Edward Grigg in December, 1931.* The subject does not constitute the major issue of that address, which is mainly concerned with migration and settlement, but the reference is sufficiently definite to indicate the trend of thought of a man than whom, in the words of the Chairman, there is probably no one with a greater knowledge of Empire affairs. It is unfortunate that Sir Edward Grigg has not seen his way to develop his views on this matter, for not only would they have been valuable, but it may be said with confidence that the system he so briefly mentioned would be found to be applicable to a much wider field of Empire development than that which formed his immediate topic. He would also, perhaps, have avoided the risk of a possible misunderstanding which might easily afford a basis for opposition. The term "Chartered Company" is associated in most men's minds with corporate bodies having extensive rights and exercising wide activities over large tracts of country—rights and activities which, from the modern point of view, are regarded as too wide and too nearly monopolistic to be acceptable. Thus Sir Archibald Weigall, speaking to the address, associates the Chartered Company with a freehold system of tenure. Such an association arises from the history of Chartered Company development. In the past, possession of the land was the only known security that could be offered with a reasonable assurance of attracting capital. It is not the land but the security which forms the essential feature of Chartered Company development; and today there exist, as it is proposed to show, other means of providing that security. It is in that historical association of the term "Chartered Company" with possession of the land that the danger lies; the use of the term here is less open to objection, for it is hoped that the scope and function of such bodies will be made clear.

Speaking to the narrower subject of migration of peoples of British stock, Sir Edward Grigg remarked: "I am convinced—I have felt this

* *United Empire*, xxiii. (1932), p. 27.

more and more in travelling round the Empire since the war—that there has not been enough private enterprise in the matter;" and, after referring to the examples of the Canadian Pacific Railway and the Kingsley Fairbridge Settlement in Australia, he asks: " Why cannot these things be done by private enterprise on a much larger scale? It is a business for private enterprise rather than for Governments." The answer to this question lay outside the scope of his address, but, undoubtedly, it must be sought in this question of security.

If land is not available as security, in what is that security for the requisite private capital to be found? If it be assumed for the moment that an answer can be found to this latter question, a further question immediately arises. Will not the Chartered Company, offered by Sir Edward Grigg as a means of development in countries open to British settlement, also afford a means of development in those vast areas of the Empire occupied by native races? In recent times and in those colonies which were the last to be opened up, and in which alien vested interests have not arisen, policy has refused, or rigidly restricted, activities by aliens; and the reason for that refusal has been the land. Land is the property of the indigenous peoples to be held directly or by the Government in trust for their benefit; it cannot be used as security for alien capital by grant of freehold. General experience associates development by alien companies having a lien on the land with expropriation of the native, who is reduced to the status of a wage labourer, and such a status is incompatible with the modern concept of the trust already mentioned. It must, however, be apparent that the Chartered Company development advocated by Sir Edward Grigg does not contemplate the migration of settlers merely to become wage labourers in the fields; they will have a certain lien on land under the Company. It follows that direct cultivation by the Company with wage labour is no more an inevitable accompaniment of Company development than is the land the only security for capital. It is only necessary to show that the same conclusion holds true in the case of territories possessing an indigenous population to make the system, advocated by Sir Edward Grigg for settlement, of general application.

In an article which the present writer contributed to this Journal almost ten years ago* he expressed the opinion that some intermediate agency, occupying a position between Government and the peasant, was essential for the full economic development of those areas in Africa in which a native population existed. As in the case of Sir Edward Grigg's address, the scope of that article hardly justified an

* *E.C.G.R.*, I. (1924), p. 240.

excursion into a consideration of the practical issues involved. These have been discussed elsewhere, and it can hardly be a coincidence that the conclusions reached indicate the need of a body having the characteristics of the Chartered Company as outlined by Sir Edward Grigg. Thus there has been reached from the very different standpoints (*a*) of European settlement and (*b*) of native progress essentially the same conclusion: the need for private enterprise in the form of the Chartered Company.

The previous article was a theoretical discussion of the subject and probably, as theoretical discussions are apt to be, somewhat indigestible. In the intervening years a wider personal outlook has been gained and there is a more extensive experience of colonial development on which to draw. While, therefore, the views then expressed remain essentially the same, it is possible to leave theory and pass to conclusions based on practical experience, providing at once a more confident opinion and a more readable account. In presenting this account it is hardly possible to limit the field to that subject in which readers of this Journal are more particularly interested—namely, cotton—for the problems of colonial development are not peculiar to any particular crop. But as the discussion proceeds and the reasons on which the needs for an intermediate agency are based become clear, it will become apparent that these reasons have peculiar force in the case of cotton.

Undoubtedly the most illuminating example of recent times of a development of the nature here under discussion, though it is not colonial, is that of the Gezira area in the Sudan. The history and structure of that development are too well known to require description, and it will be sufficient to indicate only those features which are here relevant. Briefly it is a development involving large capital expenditure on the dam and irrigation works, and covering a tract of land in which native rights in land had received recognition. On the question of capital it was early recognized that Governmental resources would prove inadequate, and the authorities rightly realized that that portion of the scheme which may be termed briefly "management" was least adapted to Governmental agency—in this accepting Sir Edward Grigg's dictum that "it is a business for private enterprise and not for Governments."

The Sudan Government, therefore, entered into partnership with the Sudan Plantations Syndicate under an agreement by which the latter body undertook the details of "management." On the question of land, a preliminary Land Settlement of the area was carried out, and a Register of Titles prepared. The Title Holders were allotted

an area in the new lay-out equivalent to their holdings as shown in the Register. From the present aspect the important point lies in the fact that means have been found for attracting private capital without granting a direct lien on the land itself, for "in fact, the whole land remains in the ownership of the actual cultivators who work upon it."* There is here an example of an intermediate agent, forming, with Government and the peasant, a triple partnership. That intermediate agent is the Syndicate, a "Chartered Company" in the sense in which the expression is used here, and it can hardly be doubted that this partnership has solved the problem of development in this case, for, in the words of the authors of 'Notes on the Gezira Irrigation Project,' "it has provided the only possible method by which a return would have been obtained on the large amount of capital that has ultimately been required." A sufficient period has now passed to test the inherent strength and weakness of the organization, and it must unhesitatingly be pronounced a success. Such weakness as it exhibits lies, not in any of the characteristics here used to illustrate the policy of the Chartered Company, but in the fact that its future is based on a single crop and lacks the measure of insurance given by a multiplicity of products.

For the present argument the interest of the Gezira project lies in the fact that it has originated in a tract where the only vested interests that required consideration were those of the indigenous population, and the somewhat nebulous nature of those interests has certainly simplified the solution of the practical problem. Not everywhere else has there been the same open field on which to build; firmly established vested interests are widely distributed and, where such exist, the nature of the structure has of necessity to be modified. Fiji offers an example of a development following essentially the same lines; based on the same fundamental principles, the structure is modified to meet the facts of existing vested interests. The facts concerning this distant island are less well known and will require a more detailed reference. Even before its absorption in the British Empire in 1874, cane cultivation had been adopted on a plantation system of the usual pattern, land having been acquired by direct treaty with the chiefs. The main difficulty encountered in those early days concerned the labour supply, and this was met by importing Indians, introduced under an indenture system. Concurrently, development in factory processes, leading to large units of the type with which the term "Central Factory" is associated, forced the

* "Notes on the Gezira Irrigation Project." Published in 1926 in connection with the opening of the irrigation system.

individual plantation out of production until gradually a monopoly of manufacture has been established in the hands of the Colonial Sugar Refining Company. Originally drawing its supplies of cane for the factories from land under its direct management and from plantations, the Company found the economic basis of its business drastically altered by the abolition of the indenture system in 1916. As elsewhere, the Indian, freed from his indentures, preferred to settle on his own plot of land rather than to continue to work for a wage, and this he was able to do under the existing system of land tenure. With existing labour withdrawing, and further supplies cut off, an acute labour shortage supervened.

The manner in which this situation was met is peculiar and enlightening. The Company proceeded to divide up its lands into small holdings of ten acres and to lease these to tenants, the majority of whom were of Indian stock. On these holdings the bulk of the cane which supplies the factories is grown. It is on the details of this organization, however, that interest centres. The Company has not used its monopolistic position to exact the uttermost farthing; it has deliberately aimed at building up a contented peasantry. It has organized a highly trained staff to supervise the tenantry, and the underlying spirit of that organization is co-operation. Though the tenure system is one of rent and not a share of the produce, advances on liberal terms are made for the purpose of implements, manure, cattle and housing material, supplies of which are organized; and a co-operative system of harvesting has been developed. The scheme has proved so successful that of 78,000 acres under cane some 63,000 acres are under peasant cultivation, and the Company has settled some 2,000 families on 21,000 acres. The development bids fair to proceed until only sufficient land remains under the direct control of the Company for the purpose of experiments and of training of staff.

Here, as the result of economic pressure, a system of production on peasant holdings has arisen which bears many similarities to, as well as some divergences from, the Gezira system. Chief among the similarities are the small unit of production and the co-operative spirit, fostered in the one case by a share in the profits and, in the other, by a definite supervisory policy. Among the major differences are the nature of the tenure and the absence of any Governmental interest in the venture. This latter is due to the two facts that vested interests in land were already in existence and that no capital expenditure such as would require the backing of Government was required to open up the country for production.

If these two examples are pondered, one striking fact emerges.

In neither case have the lines of development adopted been the consequence of *a priori* argument, they have been followed as a direct response to the pressure of economic necessity. In the case of the Gezira that pressure was exerted by the need for large capital expenditure; in the case of the Fiji sugar industry, by the shortage of labour. With the stimulus of these urgent practical problems before them, two independent organizations, one official and the other private, have been led to adopt an essentially similar solution. It must be something more than a coincidence that these two developments, which have originated from such widely different beginnings, should have adopted one and the same basic principle, peasant holding. Inevitably the thought arises, Is not this a basic principle of general application and not the hand-maiden of economic necessity? And the organization of the Colonial Sugar Refining Company, equally with that of the Gezira project, bears all the essential attributes of the Chartered Company as here conceived.

The two examples here given illustrate one direction in which a solution of the problem of agricultural development under modern conditions has been sought. A true perspective, however, can only be attained when the subject is viewed from all aspects. To give this desired perspective, the trend of development in other instances may be briefly reviewed. Agricultural communities are everywhere characterized by conservatism and it is, as a rule, only through economic pressure that radical alterations in practice, such as that noted in the Fiji sugar industry, are effected. The competition of recent years has been prolific in supplying pressure of this nature. Costs of production have had to be drastically cut down and, since in most agricultural processes labour forms the major item of expenditure, it is to economy of labour that attention is directed. In Fiji labour was the primary cause of the reorganization of the industry, and the remedy was sought in the replacement of a wage-labour system by a family-labour system where labour is paid by results. It is not, however, the only or the most obvious means of economizing on the labour charges. The Hawaiian sugar industry has met the situation in a totally different manner. Actual shortage, with consequent dearness, of labour has been characteristic of Hawaii for many years owing to the difficulties attendant on recruitment in the Philippine Islands, and the response to this shortage may be most aptly described as an intensification of the plantation system. Every effort is made to economize labour by the adoption of mechanical devices. New systems of irrigation lay-out have been evolved, the advantage of which is largely judged by their adaptation to mechanical

cultivation; special high clearance tractors have been evolved to enable mechanical cultivation to be continued up to the time the cane closes in; and, in fact, every aspect of cane cultivation is critically examined with a view to the replacement of hand labour by mechanical contrivance. For this purpose the Hawaiian Sugar Planters' Association maintain a Standing Committee on Labour Saving Devices, the activities of which form not the least important function of the Association. Nor have these activities lacked success. Though the cost of unskilled labour had risen from $18 per mens. in 1910 to $28.60 in 1931, the cost of production of a ton of sugar had only risen from $56.426 to $64.33 in the same period, while the outturn per man rose from 11·85 tons to 17·46 tons. Mechanization has undoubtedly gone far to solve the Hawaiian problem and to save the industry, but it has only been possible because there existed a true labour shortage. Clearly the method offers no general solution of the problem of agricultural development, for it is inapplicable to a country densely populated with an indigenous population, and its potentialities are strictly confined to crops, like sugar, which offer peculiar facilities for mechanical handling. But if any general application of the Hawaiian experience be impossible, it does not follow that it is entirely valueless. It is quite possible, where the conditions of site, crop and population are favourable, to combine the two systems, executing the major and heavier agricultural operations by mechanical means and leaving the lighter operations to a peasantry. Of the practicability of such an arrangement the Gezira project bears ample witness. But, for such a development, some intermediate agency capable of providing the capital and supervision seems inevitable. The Hawaiian industry has drifted away from the Chartered Company organization as here conceived. Successful as that industry has been in meeting the exigencies of recent years, it is open to doubt whether a more stable industry would not have eventuated if attempts had not been made concurrently to build up a peasantry.

One further example may be briefly described. Though the reference is to a system very far removed from the ideal of the Chartered Company, it throws a strong light on the essential features of that ideal. In the West Indies cane has been grown from early days and production was based on plantations worked by slave labour. Following the emancipation of 1834, labour shortage supervened and, as in Fiji, this was met by the introduction of Indians under indenture. Here, as elsewhere, the Indian, freed from his indentures, preferred to settle on his own plot, and, in 1882, Sir Neville Lubbock introduced into Trinidad the system of cane farming. Under this system

the peasants entered into contract with the estates to grow cane, receiving as an inducement seed cane and a money advance. The land was either their own or rented from the estate. The system has had its ups and downs; in 1921 the maximum of 57 per cent. of the cane ground was raised by peasants and the amount is now stabilized at about 40 per cent. In outward form the principle is that followed in Fiji, but its development has lagged behind in spite of its early start, and the reason is not far to seek. Little has been done to provide a supervisory staff imbued with the co-operative spirit and, as the detailed history of the movement shows, the two interests have acted generally in a spirit of rivalry, each endeavouring to extract the uttermost farthing from the other. The transactions between the two interests have formed the subject of Ordinances, and the prices to be paid for cane are not left to mutual adjustment between the interests, but are determined by an independent and official Standing Committee. Such steps can only accentuate the idea of rivalry. The system is, in fact, characterized by an absence of that co-operative spirit which is so marked a feature in Fiji.

From these few examples drawn from actual experience it is possible to outline the essential features of the Chartered Company. In its purest form, unmodified to meet particular vested interests, it will be a body having a lien on the raw produce from a tract of country, and that produce it will work up to the finished marketable product. It will not concern itself with the details of actual production except in so far as these lend themselves, under the local conditions, to be carried out economically by mechanical means, which require considerable capital expenditure on equipment. To guard the quality of the product handled, it will have limited powers of dictation as to what may be grown, charge of any special requirements such as seed supply, and a limited area under direct supervision for experimental work and training staff. Actual cultivation within these limits will be conducted by a peasantry working on holdings of a size determined by the local conditions, and a co-operative atmosphere will be maintained by a trained supervisory staff to which, possibly, will be added a direct share in the profits based on the raw produce delivered.

The position of the Company is one of restricted monopoly and, as such, requires regulation. That regulation, combined with the security which alone will attract the required capital, it will be the function of Government to define. Government will take no part in the detail of " management," but will, in fact, become to a greater or less extent a partner in the system, and the extent of that partnership will depend on the capital expenditure required to open up the

country. Government thus becomes a third party to the partnership, receiving a share of the profits proportionate to the capital expenditure incurred by it.

The central feature of this Chartered Company organization is the co-operative staff, for success depends on goodwill, and in its hands lies the power to develop that goodwill. Herein is to be found one of the strongest arguments against officially controlled development. When the Gezira project extended to 300,000 acres of cultivation a supervisory staff of some 60 officers was employed, that is, one officer for 5,000 acres. That was a figure derived from purely business considerations, for the staff required to maintain the personal touch, and proved economically justified when the cost had to be debited to the industry itself. No colony could carry a staff of this magnitude when its cost is carried as a central charge. The fact is that, for efficient organization of production, the charge for supervision must be debited to the industry, and the only way in which this can be effected is through an intermediate agent having the status of a Chartered Company. If further proof of the intrinsic value of development through Chartered Companies be needed, it will be found in this. The system has been tested under conditions so difficult that the more usual methods were found impracticable; and from that test it has emerged triumphant. Under very diverse conditions it has both established one, and saved another, industry. Surely a system which has justified itself under such extreme conditions is worthy of consideration under the more usual conditions of general experience. Historical association, which is no longer applicable, alone prevents the general adoption of the system.

And now a word more directly concerned with cotton. Cotton is peculiarly a crop adapted to peasant cultivation, for much of the field work does not lend itself to conduct by mechanical contrivances. Particularly is this the case in respect to picking; mechanical picking would appear to be as unrealizable in practice as ever and, undoubtedly, family labour is best adapted to the purpose. But cotton possesses another characteristic which makes its cultivation ill-adapted to unorganized peasant cultivation when this serves to supply any but a local market. It is an annual requiring a bulk of seed, the production of which demands much skilled supervision if quality is to be maintained. No unorganized peasantry can supply this, and some agency having effective control over the seed supply is essential to the welfare of a tract producing cotton for export. The choice lies between an official and an unofficial agency, and there is now sufficient evidence of the practical working of both to make the choice a simple one.

Objections arise not from the practical, but from the social, aspect of the matter. A true understanding of the principles underlying the Chartered Company system as here illustrated shows that these objections from the social aspect are based on a false analogy drawn from history.

Received May, 1933.

THE DIFFERENTIATION OF THE EPIDERMAL LAYER IN COTTON SEED—II.

BY

N. W. BARRITT, M.A.

Rothamsted Experimental Station.

THE question of the duration of differentiation in the epidermal cells of the cotton seed continues to justify further investigation. In the previous article on this subject in this Journal (April, 1932) the writer showed that the evidence of Gulati and Farr for the continuous differentiation of hairs from the epidermal cells of cotton seed was unsatisfactory. In the January number, 1933, Ayyar and Ayyangar, cotton specialists at Coimbatore, claim to have obtained additional evidence in support of the claims of Gulati and Farr. This evidence may be conveniently discussed under the following headings: (*a*) Cell division; (*b*) the formation of the hair base; (*c*) distinction between lint hairs and fuzz; (*d*) number of hairs per seed and lint weight.

(*a*) *Cell Division.*—In reply to a request for more definite evidence of continued mitosis in the epidermal layer, they confess their failure to observe this process beyond the second day after flowering, but claim to have discovered a new method of detecting primordial lint cells, and that by the use of this method they have obtained definite evidence of the formation of lint hairs from seven to twenty days after flowering.

This new method of detecting primordial lint cells is based on the observation of certain changes in the nucleus and nucleoli. "The resting nucleus becomes bigger and more chromatic with a few chromatic beads. It subsequently clears, after which two or three nucleoli make their appearance. These then fuse and emerge as a single big nucleolus, by which time the cell also protrudes from the epidermal layer and becomes a lint hair."

Now, in the normal course of mitosis the nucleoli disappear during the prophase and may be re-formed by the fusion of several small bodies which arise *de novo* during the telophase, whilst the nucleus is increasing in size prior to the resting stage. Thus the new appearances described by Ayyar and Ayyangar closely resemble some of the features of actual mitosis and as such would be apparent in all the epidermal cells at some stage in their development. There is no

reason to associate such nuclear changes exclusively with developing lint hairs.

The disappearance of the nucleoli and their subsequent reappearance is not known to occur except during mitosis, and the whole process is complete in a few hours. It seems incredible that some of these stages could be prolonged over a period of seven to twenty days as suggested by Ayyar and Ayyangar or that they could occur without the other more characteristic phases of mitosis. In Fig. 5B these authors give a microphotograph of a section of the seed coat said to be twenty days old and showing the incipient palisade layer of cells characterized by their small size, rectangular shape, and large nuclei. In all the sections examined by me this condition of the palisade layer occurs before the eighth day, after which these cells rapidly elongate in a radial direction. Is it possible that these authors have not been sufficiently accurate in dating their material or in keeping it distinct? Such an occurrence would explain the origin of their new method.

(*b*) *Hair Bases.*—Ayyar and Ayyangar also express their doubts as to the cause of the flattened hair bases attributed by me to the lateral pressure of neighbouring cells exerted at the upper edge of the cells. They cannot conceive of such "discretion" on the part of elongating epidermal cells. My explanation is based on considerations of elementary physics. The hydrostatic pressure developed within a turgid cell is equal in all directions, and distortion will occur along the lines of least resistance in the form of a bulge. This may occur at the top, middle or bottom of the dividing wall. If it occurs at the top the base of the hair cell will be constricted and develop a flattened base; if at the bottom it will appear pointed; and if at the middle it will appear intermediate in shape between these two. There is no reason for the pressure to be limited to the middle portion as suggested by Ayyar and Ayyangar. These authors also ask why the number of hairs with constricted and flattened bases is so few in any sample of cotton? If they are few it is because the hairs break off at the point of constriction, leaving the hair bases in the epidermis of the seed coat.

They also put forward a most remarkable, if not ingenious, explanation to account for these constricted and flattened hair bases—viz., that they arise from sub-epidermal or mesophyll cells as originally suggested by Bowman, and grow out through the stomata, the constriction being due to the adjustment to the narrow opening between the guard cells. I could not take this suggestion seriously were it not for the fact that they cite some of my own microphotographs as evidence of this. This microphotograph is reproduced in Fig. 1, in which the constricted hair base is shown firmly wedged between two

large epidermal cells. According to Ayyar and Ayyangar these epidermal cells are guard cells because of their depression from the surface. In my opinion this evidence is not sufficient for identification, and other evidence is more conclusively contradictory. Guard cells are normally situated above a stomatal cavity and are generally smaller in size than normal epidermal cells. In Fig. 1 there is no stomatal cavity, and the so-called guard cells are much larger than the neighbouring cells. Further, in Fig. 2, the true guard cells are free from pigmentation, which is not the case with those in Fig. 1 wrongly identified by Ayyar and Ayyangar.

(*c*) *Distinction between Lint Hairs and Fuzz.*—According to these authors the broad-based hairs are different in constitution from normal lint hairs, this being proved by "their different nuclear behaviour and by their reaction to cuprammonia." These considerations lead the authors to suspect that broad-based hairs are *fuzz* hairs.

With regard to the particular nuclear behaviour in lint hair cells I have no information, and I do not see how it is possible for anyone to obtain it, since by the time a fuzz hair is recognizable as such its nucleus would be difficult if not impossible to find. Neither is it possible to follow any *individual* hair cell throughout its life-history.

Whilst it is true that treatment with cuprammonium results in a swelling of the secondary thickening which is different in amount for lint and fuzz hairs, this difference cannot be used as a critical test for lint and fuzz. A similar swelling occurs in 18 per cent. caustic soda and is also different in amount not only for fuzz hairs but also for different sized lint hairs (3). Coarse lint hairs show similar reactions to fuzz in this respect, whilst fine lint hairs behave differently from both. It is difficult to see why these authors resort to such doubtful tests for fuzz hairs. Would it not be easier to distinguish between fuzz and lint by the more usual and simpler method of measuring length and breadth ? I do not see any reason for supposing a difference in the mode of nutrition of lint and fuzz hairs.

(*d*) *Number of Hairs per Seed.*—Ayyar and Ayyangar conclude their article with a table of results of determinations of lint weight, unit fibre weight, and number of fibres per seed of the 9 seeds from single locks of two types of Cambodia cotton. From this table it is concluded that the lint weight per seed is influenced by the number of fibres per seed and not by the unit fibre weight. The actual figures show a correlation between numbers of fibres and lint weight of +0·66. According to Fisher's table of significance for nine pairs of results the coefficient must not be less than 0·7 for the correlation

to be significant. From which it follows that the above conclusion of these authors is not justified.

It should be noted that the figures for unit fibre weight show remarkable uniformity, and since the number of fibres per seed is merely the ratio $\frac{\text{lint weight}}{\text{unit fibre weight}}$, it is not surprising that the authors expect the lint weight to be influenced by the number of fibres rather than by the unit fibre weight. If conditions within a single lock are such that the lint hairs of all the seeds attain a uniform fibre weight it follows mathematically that the number of hairs will not only be correlated with, but will actually determine, the hair weight per seed. The converse of this is also true, and was pointed out by Iyengar and Turner (4). If this occurred, it would imply a common source of nutrition for the developing hairs, and confirm my theory of the surface nutrition of the hairs from the boll cavity.

Thus, if their table means anything at all, it supports rather than contradicts the conclusions, *a priori* and otherwise, made in my previous article. It is not to be expected that the conditions of nutrition in different bolls will be anything like comparable, and this is reflected in the variations of 20 to 40 per cent. in unit fibre weight recorded by Turner for Punjab cottons (7). The following table is taken from Turner's bulletin (6) on ginning percentage and lint index of individual bolls of a strain of Aligarh cotton.

TABLE I.

Boll Number.	*Lint Weight per Seed in Mgms.*	*Unit Fibre Weight* 10^{-3} *Mgms.*	*Number of Fibres per Seed.*
II.	41·9	6·36	6,590
VII.	43·0	5·71	7,530
III.	43·6	6·78	6,430
V.	47·3	6·89	6,870
I.	42·6	6·64	6,420
VI.	42·6	5·87	7,250
VIII.	39·7	6·09	6,520
XV.	39·7	4·52	8,780

In this case the correlation coefficient between lint weight and number of fibres per seed is −0·32, which is quite insignificant, whereas the correlation between lint weight and unit fibre weight is +0·67, which though hardly of much significance for such a small number of results, shows that lint weight per seed is more influenced by unit fibre weight than by the number of fibres per seed.

With regard to the actual figures for the two strains of Cambodia

cotton given by Ayyar and Ayyangar and reproduced below (Table II.), it is obvious at a glance that the figures for number of fibres per seed are not correct, since on dividing the figures for lint weight by the unit fibre weight a different number is obtained in each case. It is not to be supposed that these authors actually counted the 250,000 hairs which make up the total.

TABLE II.

	Strain CO.1.				*Strain CO.2.*			
Position of Seed in Boll.	*Lint Weight in Mgms.*	*Unit Fibre Weight* 10^{-3} *Mgm.*	*No. of Fibres per Seed.* *Ayyar and Ayyangar.*	*Barritt.*	*Lint Weight per Seed Mgm.*	*Unit Fibre Weight* 10^{-3} *Mgm.*	*No. of Fibres per Seed.* *Ayyar and Ayyangar.*	*Barritt.*
1	64·7	5·02	13,270	12,888	65·2	5·44	12,340	11,985
2	65·6	5·34	12,680	12,284	66·4	5·17	13,170	12,843
3	67·9	5·31	13,240	12,787	73·7	5·30	14,220	13,900
4	68·2	5·15	13,640	13,242	75·6	5·26	14,810	13,802
5	68·4	5·10	13,810	13,411	75·8	5·08	15,300	14,921
6	68·6	5·18	13,640	13,243	77·7	5·00	15,910	15,540
7	69·0	5·12	14,000	13,652	77·5	5·13	15,370	15,107
8	73·0	5·29	14,250	13,800	82·2	5·18	16,270	15,868
9	69·3	5·54	12,890	12,509	80·6	5·54	15·040	14,548

In a paper by Iyengar and Turner (4) the number of fibres per seed for CO.1 is given as 15,000, which is considerably higher than the values given above, and in the Technological Reports on standard Indian cotton (8) I find the average fibre weight per cm. of CO.1 during five seasons was $1{\cdot}76 \times 10^{-3}$ mgms., and that of CO.2 during four seasons was $1{\cdot}55 \times 10^{-3}$ mgms. Multiplying these figures by the mean fibre length 23·1 mm. we get 4·06 as the unit fibre weight of CO.1, and 3·58 for CO.2, which figures are considerably less than those given by Ayyar and Ayyangar in the above table. These large discrepancies in fibre weight suggest that the zero of the micro-balance used by these authors was not properly adjusted, and the arithmetical differences in the number of fibres per seed also betray carelessness.

Further, in a very recent paper, Sen and Iyer (5) give the results of fibre properties for a strain of Punjab-American cotton and show (*a*) that lint weight per seed is the most variable character, and (*b*) that the only significant correlation between pairs of characters for cotton seed within the same boll is that between lint weight per seed and mean fibre weight per unit length, which is +0·93, thus fully confirming my statement.

In conclusion, it may be said that, while it is never safe to make conjectures at any time or even to make statements on *a priori* grounds, both these risks may be justified by subsequent events; but carelessness in obtaining data and in their subsequent interpretation can only lead to confusion.

REFERENCES.

(1) AYYAR, V. R., and AYYANGAR, G. S. (1933). "Differentiation of Hairs on the Seed Coat of Cotton." EMPIRE COTTON GROWING REVIEW, X., 1, 21.
(2) BARRITT, N. W. (1932). "The Differentiation of the Epidermal Layer in Cotton Seed." EMPIRE COTTON GROWING REVIEW, IX., 2.
(3) BARRITT, N. W. (1929). "Some Properties of the Cell Wall of Cotton Hairs." *Ann. Applied Biology*, xvi., 3, 438.
(4) IYENGAR, R. L. N., and TURNER, A. J. (1930). Ind. Cent. Cotton Comm. Tech. Bull. B, No. 7.
(5) SEN, K. R., and IYER, S. S. (1932). "On the Variation of Certain Characters of Cotton in Relation to the Position of Seeds in a Lock." *Ind. Journ. Agric. Sci.*, ii., 5, 484.
(6) TURNER, A. J. (1929). "Ginning Percentage and Lint Index in Relation to Number of Fibres per Seed." Ind. Cent. Cotton Comm. Tech. Bull. B, No. 13.
(7) TURNER, A. J. (1930). "Technological Reports on Standard Indian Cottons." Ind. Cent. Cotton Comm. Tech. Bull. A, No. 14, p. 27.
(8) TURNER, A. J. *Ibid.*, p. 119.

EXPLANATION OF PLATE.

Fig. 1. T.S. of seed coat at maturity, showing constricted base of lint hair between two pigmented cells, and absence of stomatal cavity.
Fig. 2. Surface view of epidermis at 25 days, showing relative sizes of guard cells and epidermal cells and base of lint hairs. Same magnification as Fig. 1.

Received February, 1933

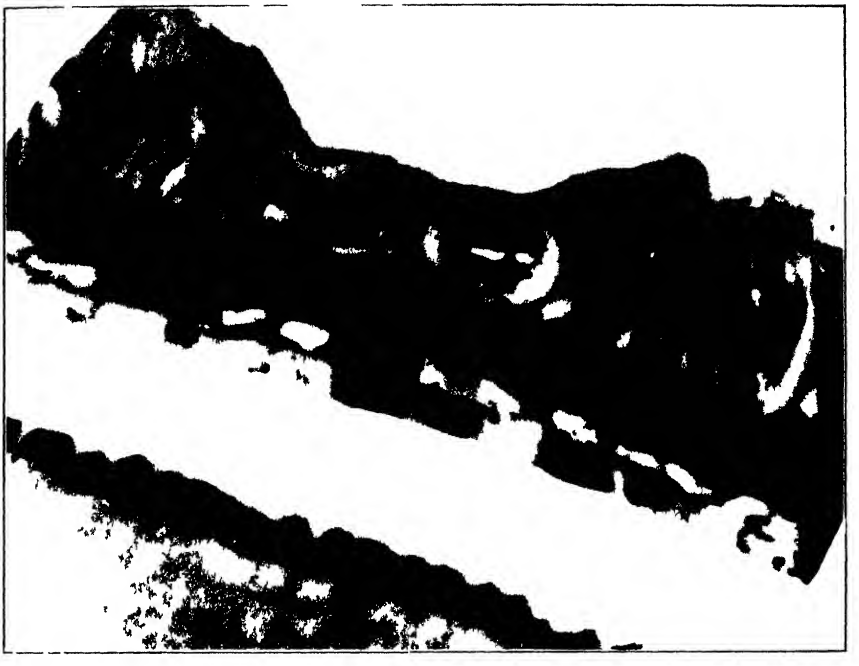


Fig. 1.

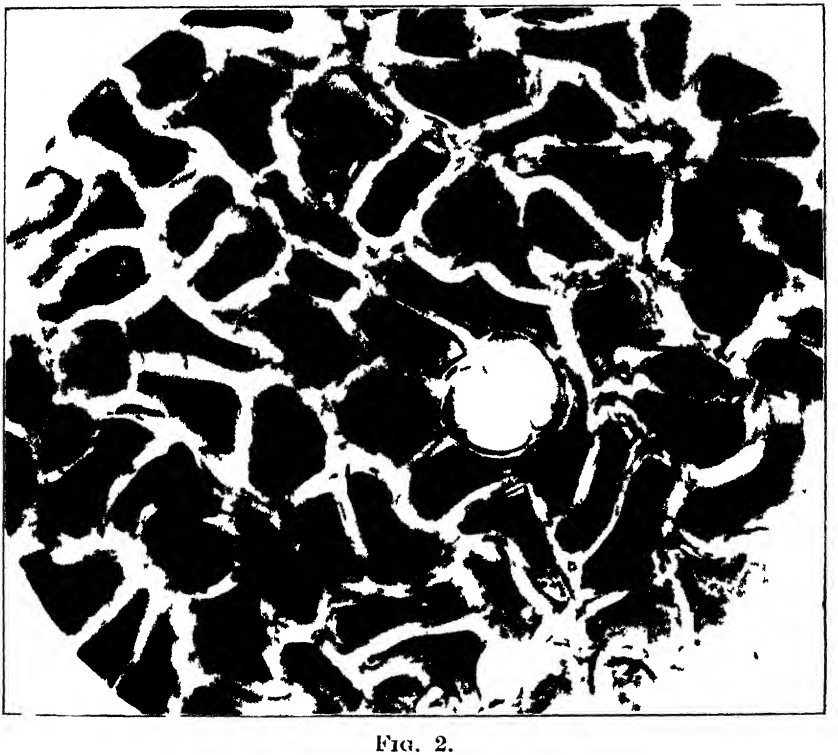


Fig. 2.

JOHN BRIGHT AND INDIAN COTTON

BY

W. O. HENDERSON,

Lecturer in Economic History at the University of Liverpool.

JOHN BRIGHT was the most distinguished statesman in the nineteenth century to advocate the encouragement of cotton-growing within the Empire, and particularly in India. He began by regarding India purely through Lancashire's spectacles—as an alternative source to the Southern States of the U.S.A. for the supply of the raw material which Lancashire needed, and as a customer for the finished article. He gradually took a broader view of India's problems, and was for many years an advocate of reformed administration in India.

In December, 1847, Bright asked a question in the House of Commons on the steps that were being taken to promote the construction of railways in India " particularly from Bombay to those districts in which cotton is chiefly grown." He said that Lancashire in that one year had paid as much owing to the failure of the crop in America as would have paid for the line which the Great Indian Peninsular Company wished to make. The subject was of the first importance to Lancashire.

A Select Committee of the Commons, with Bright in the chair, investigated the question of the growth of cotton in India and reported in July, 1848. Thomas Bazley, President of the Manchester Chamber of Commerce, stated in his evidence that the recent failure of the cotton crop in the U.S.A. had led to considerable hardship in Lancashire. J. Forbes Royle, who had been Superintendent of the Botanical Gardens at Saharunpur for nine years, said that Indian cotton supplies had not developed rapidly owing to " the irregularity of the prices and the irregularity of the demand." Further, cotton " requires a certain climate: as this is not regular the crops often fail." He mentioned that the American planters who had been brought to India in 1840 by the East India Company to attempt to grow American cotton by their own methods and with their own implements had not met with much success. Another reason for lack of cotton from India was the inadequacy of internal communications. R. D. Mangles, a Director of the East India Company who had been sixteen years in India, said: " I am quite ready to admit that the Government of

India* have not done what I think might have been done, and ought to have been done, in the way of public works." The Report of the Committee considered that cotton cultivation in India was capable of considerable extension. It was necessary to improve the condition of the peasants—many of whom were in the hands of moneylenders—by making assessments for rent more equal and less arbitrary; and in addition facilities for transport urgently needed improvement. John Bright's work on this Committee gave him an interest in the problems of Indian cotton supply and of Indian affairs in general that he never afterwards lost.

Eighteen months later a special general meeting of the Manchester Chamber of Commerce was held to discuss the cotton supply problem (January 17, 1850). Bazley was in the chair and Bright was present. Five resolutions were passed: the fourth ran as follows: "That this Chamber, contemplating the early expiration of the East India Company's charter, is of opinion that a special commission of enquiry should be sent forthwith to India to examine into the condition of the country, especially within the Presidencies of Bombay and Madras, with a view to ascertain what are the obstacles to the growth of cotton, and to the extension and permanence of a profitable industry in the cultivation of the soil: and the Chamber is also of opinion that the report of such a commission would furnish invaluable information to the Legislature and the public before the consideration of the future government of India is again brought before Parliament." It was decided to petition the House of Commons in favour of such an enquiry.

The "petition from the merchants, manufacturers and other inhabitants of Manchester, praying for a commission of inquiry with regard to the growth of cotton in India" was presented to the Commons by John Bright on June 18, 1850. In his speech he stressed the importance of the Lancashire cotton industry both as regards the number of persons employed and the amount of capital invested. He pointed out that "whilst the consumption of cotton has been increasing in this country, it has also been increasing to a great extent on the Continent and in the United States of America. I was not a little startled by discovering the fact that the United States in 1849 consumed a larger quantity of cotton than the whole growth of the States produced in 1824." He added that slavery could not last much longer in the Southern States, and its removal was bound to cause at least a temporary dislocation in the cotton supply. Sir John Hobhouse criticised Bright's proposal and said that it was "tan-

* *i.e.*, of the East India Company.

tamount to a supersession of the East India Company." Sir J. W. Hogg repeated a suggestion he had made on a previous occasion and advised the Manchester manufacturers themselves to send out a commission to India to obtain the desired information. Bright's motion to address Her Majesty in favour of appointing a commission was lost.

This was a great disappointment to Bright, and a few months later (November 4, 1850) he wrote to Lord John Russell, the Prime Minister, that he " never could discover a single valid reason against the commission," and that " no motion made in Parliament was ever opposed on more flimsy pretences." " My object, however, in obtruding upon your time now," continued Bright, " is to state that the prospects of the trade of Lancashire are if possible more gloomy than last year, and from apprehended and almost certain failure this year of the American cotton crop. Cotton is double its natural price: and a large portion of the whole trade is carried on at a serious loss, and none but the very finest branches, where the cost of cotton is not of much consequence, are conducted with a profit. I can assure you that this question is of serious import, and that it deserves the anxious consideration of Government. We do not ask for bounties, or protection, or encouragement, or even sympathy, from the Government; but we do ask that when it is believed on adequate grounds that one of the dependencies of the Empire is well qualified by soil, climate, and population at once to supply us with the raw material, and to become, to a much greater extent than is now the case, the customer for our manufactures, and when there is strong reason for believing that the obstacles which interpose are either those which Government has made, or which Government can remove, I say we do ask that this great question should be enquired into, and the public anxiety upon it set at rest."

Nothing came of this appeal and Bright devoted much time during the winter of 1850-51 to studying the problem of Indian cotton supply and to writing articles on it in the *Manchester Examiner*. He took up the suggestion that had been made during the Commons debate in June, and with the help of cotton manufacturers interested in the subject set about raising funds to send out a commissioner to investigate the matter on the spot. The decision to appoint a commissioner was made in November, 1850, at a meeting convened by the Manchester Chamber of Commerce, at which the co-operation of the Chambers of Commerce of Liverpool, Blackburn, and Glasgow was obtained. Eventually £2,000 was raised to cover expenses. The commissioner chosen was Alexander Mackay, a Scottish journalist

whose reputation rested on his book, "The Western World," which dealt with conditions and public opinion in the United States. His mission was "to enquire into the obstacles which prevent an increased growth of cotton in India; and into any circumstances which may injuriously affect the industrial condition of the cultivators of the soil, more especially within the Presidencies of Bombay and Madras." Mackay went to India in 1851 and stayed there for about a year. Unfortunately his health failed. He embarked for England before his investigation had been completed and died on the boat on April 15, 1852. His reports, edited by J. Robertson, were published in 1853 under the title "Western India." Most of the criticisms made in the Report of Bright's Committee of 1848 were repeated. Roads were very poor,—in Guzerat there were none "in the civilized and ordinary sense of the term." Harbours were most unsatisfactory. Fraudulent packing of cotton was not being stopped by inspection, for inspectors were often corrupt. Mackay's mission is important as an example of an enquiry made on behalf of the manufacturers without any help from the Government. It may be compared with an enquiry undertaken in India at the same time by Mr. Lees for the Manchester Commercial Association and with the later investigations by G. R. Haywood in Egypt and India (1861-62), the Bombay and Lancashire Spinning Enquiry of the Manchester Chamber of Commerce (1888), and the mission to China of the Blackburn Chamber of Commerce in 1896-97.

In the next ten years Bright's worst fears were fulfilled. First came the Indian Mutiny, and with it ended the rule of the East India Company which Bright and others had so often criticized. The disorganization caused by the Mutiny delayed still further the carrying out of those public works—the construction of roads, railways, canals, harbours, and irrigation works—without which little progress could be expected in developing India's cotton supplies. Secondly, the American Civil War, by cutting off the bulk of our cotton supply, brought about a crisis in the Lancashire cotton industry, which was already in an unhealthy condition owing to the overproduction of cotton yarn and cotton goods in the years 1859-60. Bright was opposed to slavery and supported the North. He continued to press the Government to encourage cotton-growing in India.

On June 5, 1862, Bright suggested in the House of Commons that the subject of Indian cotton should be discussed at the same time as the Indian Budget. He warned the House that "if nothing were done in India, we should find that for two or three years to come the condition of Lancashire would be such as to cause the greatest con-

cern to the House, to create great embarrassment to the public finances, and to produce, perhaps, difficulties over the whole country greater than hon. members anticipated." In the following year (July, 1863) he supported Caird's motion for the appointment of a Select Committee " to enquire whether any further measures can be taken, within the legitimate functions of the Indian Government, for increasing the supply of cotton from that country." He stressed the difficulty of the whole problem and said that it could hardly be solved " by any legislative or administrative miracle, such as some hon. members and some persons down in Lancashire seem to imagine to be possible. . . ." He concluded by criticizing the new rules for the sale of waste lands in India issued by Sir Charles Wood (the Secretary of State for India). At the end of the discussion Caird withdrew his motion.

English imports of Indian cotton increased considerably during the period of the Cotton Famine: the quality, unfortunately, was not good. Bright's long agitation was thus not without result, though he himself would have wished for a greater measure of success. When normal supplies of cotton from America came again in the 'seventies, interest in the cotton supply question languished. Thus the Cotton Supply Association, which had been formed in 1857 and had done excellent work in the 'sixties despite the limited means at its disposal, came to an end in 1872. Bright's interest in Indian affairs continued. In December, 1877, for example, he spoke at a meeting of the Manchester Indian Association in support of a scheme which Sir Arthur Cotton had long been advocating—the improvement of the navigation of the River Godavery and the development of an irrigation system based upon this river. Bright pointed out that the recent famine in India had shown the imperative need for the further improvement of communications. He also criticized the Indian import duties on English cotton goods. But there was no reference to Indian cotton. The subject that had attracted Bright to the study of India and her problems thirty years before had given place to questions of greater immediate urgency.

John Bright thus has an important place in any account of the attempts to encourage the growth of Empire cotton in the nineteenth century. Ministers and permanent officials might shelve the memorials of the Manchester Chamber of Commerce or the Cotton Supply Association: they might pay scant attention to a case presented by manufacturers whose influence declined as they travelled from Lancashire to London, but a claim supported by a speech of Bright's secured the attention not merely of the Government but of

the country. His advocacy assured to Lancashire's claims a hearing that they would not otherwise have obtained.

BIBLIOGRAPHICAL NOTE.

Hansard (3rd Series), xcv. (December 10, 1847), cxii. (June 18, 1850), clxvii. (June 5, 1862), clxxii. (July 3, 1863); Parliamentary Papers, 1847-8, ix. (Report from the Select Committee on the Growth of Cotton in India); *The Times*, January 18, 1850 (for report of meeting of Manchester Chamber of Commerce on previous day); Thorold Rogers, "Speeches of John Bright" (1876), pp. 104-6; G. M. Trevelyan, "Life of Bright," pp. 169 and 317-8; R. A. J. Waller, "Diaries of John Bright" (1930), pp. 113 and 253; G. P. Gooch, "Later Correspondence of Lord John Russell" (1925), ii., pp. 286-7 (for Bright's letter to Russell of November 1, 1850); Alexander Mackay, "Western India" (1853).

Received January, 1933.

PROGRESSIVE EVOLUTION

BY

C. C. HURST, Sc.D., PH.D. (CANTAB.).

EVERY year we have fresh evidence of the continuous progress of life; the mind of man is ever devising greater surprises, and we can imagine that the future will hold many more wonders than the present. Away behind us stretch long ages of time during which primitive types of life gradually evolved into the complex types of today. Everywhere we see progress in evolution, a very gradual progress it is true, but each period shows a definite advance in its fossil remains compared with the periods before it, until we finally arrive at the great complexity of life in the world today. The question naturally arises, " How has this progress been achieved ?"

To understand how this has happened it is necessary to review the elementary processes of evolution. The time has long gone by when people looked askance at the doctrine of evolution. The average man in the street looks on it as a happy solution of the old theological difficulty of creation in seven days which was a continual stumbling-block to his common sense. The discoveries of Mendel and the subsequent elucidation of many problems of inheritance have thrown a flood of light on the previously obscure workings of evolution. Though impeded by a controversy which, in spite of its being limited to the more scientifically minded, was quite as bitter as the previous Darwinian upheaval, Mendelism under its newer name of Genetics has been a firmly established experimental science for nearly a quarter of a century. The discovery by Hunt Morgan in the first decade of this century that the elusive heritable factors or characters of an organism are definitely associated with certain physical constituents of the cells within that organism, opened up unlimited possibilities for research in inheritance and evolution. More and more the science of Genetics is becoming bound up with the study of evolution. The great problem of the origin of species has already been solved in several cases by the actual creation of new species or, more convincing still, by the experimental creation of existing species, and it is now possible to view the progress of evolution within the laboratory.

Within each cell in the body of every living thing, human, animal

or plant, are small rod-like bodies known as chromosomes. Within each of these, again, is a string of genes, particles of a molecular nature, but differing from ordinary molecules of matter inasmuch as they have the power of growth and self-reproduction. Each of these genes controls some part of the growth and development of the organism, and they are identifiable with the "factors" of the Mendelian theory. Later work has definitely proved, however, that it is not so much to the action of individual genes that we must look, but to the interaction of the whole gene complex. Many characters in an organism are controlled by quite a number of genes, one of which is mainly responsible for the reproduction of the character, the others being "modifiers." In addition to their united action on one character some genes will also interact with the adjacent genes controlling other characters, so that although most genes have a constant specific nature of their own, it is chiefly to the whole gene complex that we must look for the full development of the organism, and any serious accident to, or defect in, this gene complex leads at once to the death of the individual, or, in less extreme cases, to its inability to produce offspring.

Since the gene complex in its only tangible form is represented by the chromosome complex of a plant or animal, the study of the chromosomes has become of prime importance, and no plant geneticist worthy of the name will undertake any piece of work without making a comprehensive study of the chromosomes of his chosen subject. This has proved of extraordinary help to plant breeding, for many quite unlooked-for facts have been brought to light and years of labour saved in many cases by the realization after examination which matings were possible and which impossible. It is satisfactory to know that the chromosomes of the cotton plant are now being systematically investigated at King's College, London, by Professor Ruggles Gates and his research workers, and also by Dr. Harland and his assistant at Trinidad, and the Russian geneticists in Turkestan.

Each cell in any individual has exactly the same number of chromosomes, and when an old cell divides to make two new ones during the growth of the animal or plant, the chromosomes and genes split exactly in half lengthways and each new cell receives an exact replica of the chromosomes and gene complex of the parent cell. When the germ cells are formed the chromosomes do not split, but form up in pairs, there being two of each kind of chromosome in the body cells, and one chromosome of each pair goes into the new cells formed, so that the pollen or sperms and the egg cells contain exactly

half the number of chromosomes of the parents. Thus the new individuals arising from the union of the germ cells have the same number of chromosomes as in the parents, and each typical individual of a species has the same number also. Different species, however, may differ in their chromosome number or in the size or shape of the chromosomes, and different genera and families usually vary much in their chromosome complexes.

In this discrepancy of the complexes lies the answer to the question why even apparently nearly related species will not cross together in many cases. If one species has six chromosomes in its germ cells and another has seven, when they come together we have an individual with thirteen. Incompatibility arises from the start. The odd chromosome is without a mate to pair with, and yet the complex to which it belongs is incomplete without it and the genes it carries. All sorts of irregularities occur, and few or no fertile germ cells can be formed. In cases of wider discrepancies irregularities will occur in the body cells, the complex from one parent working at different times from the complex from the other parent and so precluding any growth at all.

It is also chiefly to these gene and chromosome discrepancies between species and species, genus and genus, family and family, that we must look for the evidence for progress in evolution. In the most primitive forms of life the gene complexes are extremely simple. In the lower forms there are even no chromosomes, but only scattered chromidia, little aggregations of chromatin material each containing a few genes or, in some cases, only one. In the lowest forms of all, the filter-passing viruses, which are responsible for some of the worst diseases of animals and plants, and the even more minute bacteriophages which consume bacteria, we reach the very borderland of life and matter, and from their action we infer that here we have only one or, at the most, only a very few genes present. In the more extreme cases they can hardly be regarded as genes even, but as some form of progene or autocatalytic molecule which may represent the transitional condition between life and matter.

From these primitive forms to the higher plants and animals we find an ever-increasing complexity of form and structure in the intervening stages, not only in the present inhabitants of the world, but more particularly in fossil remains. The very earliest fossils are of an extremely elementary nature, but with each succeeding period the variety and complexity of animal and vegetable life gradually increases. Rudimentary as the earliest fossils are, one must nevertheless realize that even these are advanced types compared

with the forms which must have preceded them, for it is obvious that until some solidity in structure appears there can be no fossil remains. The countless hordes of one-celled and precellular organisms, resembling the present bacteria, viruses and bacteriophages, which must have been the first inhabitants of the world, can leave no trace behind, except in rare cases.

Together with the evolution of higher types of organisms comes the evolution of sex, at first so rudimentary as to be hardly recognizable, but always gradually increasing in perfection. The importance of this evolution of sex can hardly be overestimated, for it gives the opportunity for segregation of characters and for the formation of countless recombinations of old characters and of the new ones which arise from time to time. As a factor in the progress of evolution, sex must be given a place of the first importance.

From the primitive forms to the higher plants and animals we may find every type of chromosome and gene complex. The number of chromosomes may vary from one pair to one hundred pairs, the size may vary from some so small that they are difficult to see even with the highest-powered microscopes, to others which are large enough to be seen under a comparatively low power. How these differences in gene complex have arisen has been fully demonstrated in many genetical experiments. Primarily most of these experiments have been started for the elucidation of some genetical problem, but they have equally elucidated the problems of the workings of evolution (Hurst, 1932, A)

Probably the evolutionary process which has the greatest influence of all is the change which occurs from time to time in the genes themselves. Exactly how this occurs is as yet unproved, but it would appear that some part of a gene—probably certain electrons in its chain of atoms—becomes lost or inactive by some external or internal influence or by some inaccuracy of division, so that its customary reaction is changed or modified. The fact that this can be achieved artificially by X-raying is most suggestive (Patterson and Muller, 1930). The most striking example of these changes, and one which is familiar to all, is when a plant suddenly "sports" a new flower colour or other character differing from the normal. If this character is inherited by future generations it is caused by a change in the gene which controls it, and the change is termed a "mutation." These genic changes occur rarely; in fact, the normal stability of the genes, considering all the vicissitudes to which they are subjected during their everlasting divisions in the growth of new cells, is really remarkable. When changes do occur they are more often than not

harmful. Every organism is so perfectly attuned to its environment and the gene complex is so interdependent that even a small change in its internal constitution may cause such an upheaval in its normal equilibrium that disaster follows. This is especially true of changes of a physiological nature. Occasionally, however, a mutation occurs (such as a change in flower colour) which is not definitely disadvantageous to the organism, and this may be perpetuated in future generations. Very rarely mutations occur which give the individual concerned a definite advantage over the rest of its fellows, such as a new and necessary physiological character arising in a changing environment.

Although these advantageous mutations are extremely rare, yet, occurring spasmodically throughout long ages of time and in all organisms, they have given rise by accumulation to the many divergent characters which differentiate one family from another and one phylum from another, and they may undoubtedly be regarded as the prime cause of the great variation in nature. They cannot alone give rise, however, to the complexity which we find everywhere when studying chromosome complexes and their accompanying gene and character complexes. To get this there must also be changes (transmutations) within the chromosomes themselves. These have been proved to be many and various, and are probably as frequent as or more frequent than genic changes.

The most simple change within the chromosomes is the transference of a piece of one chromosome to another chromosome. This may occur by the chromosomes becoming entangled during a division causing a breakage in the chromatic thread, and the broken piece becoming fixed on to another chromosome. At the first glance one would suppose that this could have no effect whatever upon the individual concerned, as it is merely the removal of certain genes to another part of the same complex. In following generations, however, the chromosomes with the added piece will find their way into individuals which still retain the normal chromosome complex, and in time individuals will arise which have a pair of the normal chromosomes and a pair with the added piece, so that this particular piece is now present four times in every cell instead of only twice. This condition usually has the effect of accentuating or enlarging all the characters controlled by the genes in this duplicated section, and the chromosome complex also differs from the normal by one pair of longer chromosomes. Given isolation, we have here an incipient species, and it has been proved experimentally that one large genus of plants (*Crepis*) has formed many of its species in this way (Babcock and Navashin, 1930).

As a factor in evolution this duplication of chromosome sections has added immensely to the complexity of the gene and chromosome complexes. At one step a whole group of genic controls for certain characters become duplicated, and for each character concerned there are now four genes in command where there were only two previously (Fig. 1). Followed by other sectional duplications and further complicated by mutations, it is doubtless one origin of the multiple genes which are known to control many characters, and the gene complex becomes an interacting whole by the effect of these scattered but similar genes. The chromosome complex is altered and varying lengths of chromosome arise, and each alteration brings with it changes in the appearance of the individuals concerned and the birth of new varieties and possibly species.

The second chromosomal change is of a somewhat similar nature, but in this case not a section, but a whole chromosome, becomes duplicated. It is a fairly common occurrence in some species for irregularities to occur during the formation of the germ cells, whereby both chromosomes of a chromosome pair go into the same germ cell instead of into two different ones. Since this particular germ cell now contains an extra chromosome, any fertilization effected by it will necessarily give rise to an individual with an extra chromosome. This has occurred very frequently in many experimental cultures and has been one of the chief means of identifying the genes in any particular chromosome. Since this additional chromosome affects all the characters for which it bears the genes, it is easy, in a species which carries chromosomes of different sizes, to assign the genes to whichever chromosome is observed to be in triplicate.

In cultures it has been found extremely difficult, and in some cases impossible, to fix this chromosome type. To do this it is of course necessary to get progeny with the extra chromosome in a paired condition. This sounds easy enough, but in practice there are many pitfalls, the greatest being that at the formation of gametes any chance single chromosomes rarely participate in the regular division of the paired chromosomes and are consequently left behind and lost, or in some cases they so upset the normal workings of the division that everything degenerates. Unless both male and female germ cells can be formed bearing the extra chromosome there is no possibility of a fixed condition being attained, and most of the numerous cases of extra-chromosomed individuals are destined to die out. That some permanent forms arise, however, is evident, for so many cases occur where nearly related genera or species differ from one another by one or more extra pairs of chromosomes. This may occur by the

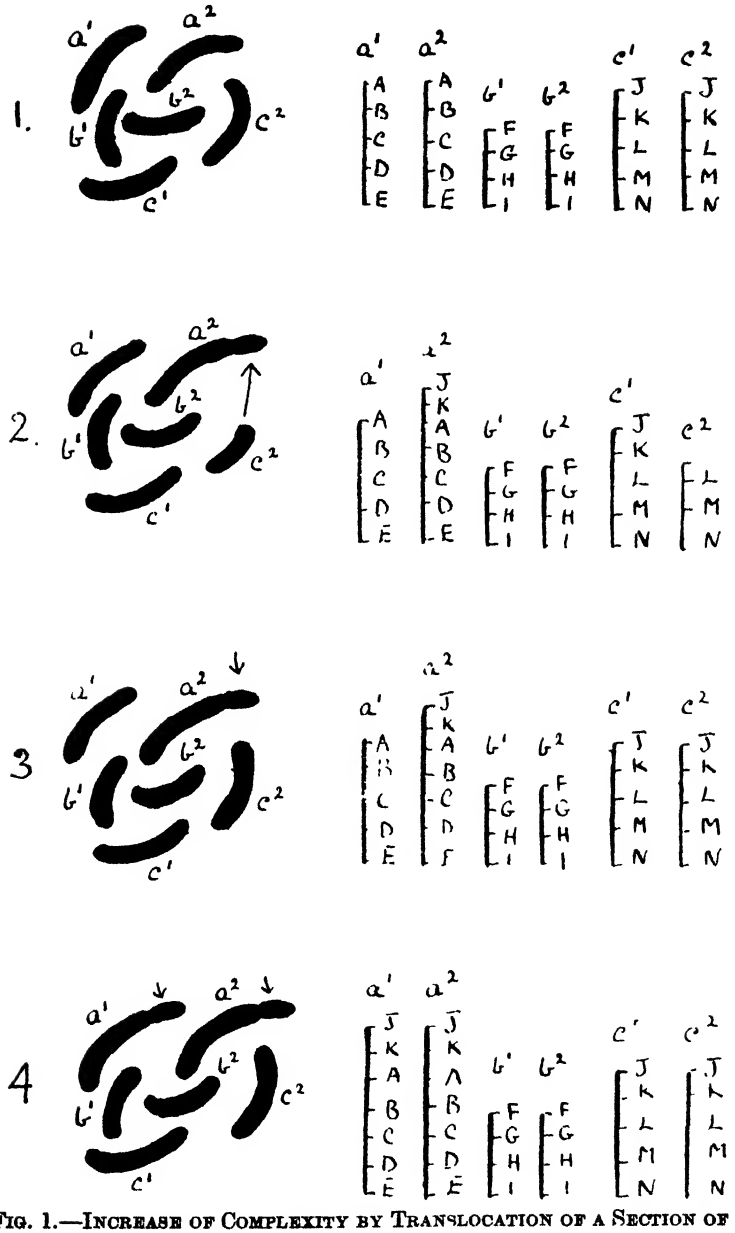


FIG. 1.—INCREASE OF COMPLEXITY BY TRANSLOCATION OF A SECTION OF A CHROMOSOME.

Left, the chromosome complexes. *Right*, the maps of the chromosomes, the letters standing for genes.

1. Normal complex. 2. Complex with a piece detached from c^2 and joined on to a^2. 3. At fertilization the longer a^2 passes into a complex with a normal c^2. 4. In later generations a complex arises with a pair of long *a* chromosomes and a pair of normal *c* chromosomes, the genes J-K being present four times instead of twice.

breaking up of a large chromosome, but it has been experimentally proved in at least one large genus (*Pyrus*) that they have arisen by the duplication of other chromosomes (Darlington and Moffatt, 1930).

Like the duplication of segments of chromosomes, which are also difficult to "fix" and often cause pathological disturbances, the duplication of entire chromosomes is a very potent factor in the general progress of evolution. Since it concerns many more genes, it has a much greater effect on the external appearance of the individual, and the duplication of many more genes involves greater complexities of genic control and balance. This is another way in which characters come to be controlled by more than one gene, and these genes being situated in different chromosomes are subject to individual mutations, thus giving rise to very complex multiple reactions upon the same character. The addition of extra chromosomes also introduces a new chromosome complex which gives rise to a considerable sterility barrier between the new individuals and their parents, thus fulfilling one of the principal conditions for the origin of a new species.

An even greater cause of complexity is the duplication of the entire set of chromosomes as in the case of the American cottons. This occurs frequently throughout the vegetable kingdom and to some extent in the lower animals, especially in those which are hermaphrodite or self-fertilizing. In the higher animals it has not yet been demonstrated, the difficulties of perpetuating it in these being very great owing to matings rarely taking place between nearly related individuals, whereas in plants self-fertilization or matings between nearly related individuals are the rule rather than the exception.

This duplication of the entire chromosome complex is of two distinct types. In the first type the complex of an ordinary individual becomes duplicated either by the suspension of a cell division in the body producing a cell with double the number of chromosomes and subsequently a whole area with this abnormality, or by a similar occurrence in the gametes or germ cells. This type of duplication has little importance from the point of view of character differentiation. Since all the genes are duplicated, the genic balance is more or less maintained, and the only distinction from the parents is usually a great increase of size in all parts. The increase in chromosome number, however, raises a considerable sterility barrier, and these may, by gene or chromosome changes, become further differentiated and form good new species of far greater genic complexity. The large number of chromosomes present in these duplicated varieties naturally provides more material for variation than in the original

species and further duplicates the genic controls of all characters (Ljungdahl, 1924).

The second type of duplication is of far greater importance, and it has evidently played a very considerable part in the evolution of many large and important genera, such as the cotton genus *Gossypium*. This type originates from the hybridization of two distinct species which gives rise to a sterile hybrid. By a suspension of a cell division parts of the plant may arise with twice the number of chromosomes, and since each chromosome is now paired, normal germ cells can be formed and normal progeny arise. In other cases the hybrid may form a few germ cells with the entire number of chromosomes, without any change in the body cells, and rare plants arise from these with twice the number of chromosomes. In either case an interesting and important new species is formed combining the characteristics of two species but very different from either, since the sum of their characters gives a very distinct result and an entirely new and extremely complicated genic balance (Fig. 2). Experimental hybridizations followed by duplication and new species formation have been successfully carried out many times in various plant genera, and in a few cases even distinct genera have been used showing how divergent these new species may be. This has opened up vast possibilities in crop breeding, since in this way one can bring together two species (or more by further hybridizations) which have useful characteristics and so enhance their usefulness (Karpetschenko, 1929).

The discovery that so many changes can take place in the nature and construction of the chromosomes and consequently in the characters of plants and animals has widened our conceptions of the workings of evolution enormously. Every change in the chromosome complex such as has been discussed here gives an added complexity to the gene content of the individuals concerned, and the gradual progress of life from lower to higher levels is the result of the gradual building up of more and more complicated chromosome complexes. It is true that many of the changes which take place so upset the balance of the individual that it dies or is sterile. This is especially true of changes in the genes themselves, and also in the cases of translocations of portions of chromosomes. As these changes, however, are taking place continuously, though rarely, from age to age and throughout all species, it is evident that by all the laws of chance some few of them must be advantageous, and these isolated successes are amply sufficient to produce the grand sum total of evolution. From a lowly condition similar to the filter-passing

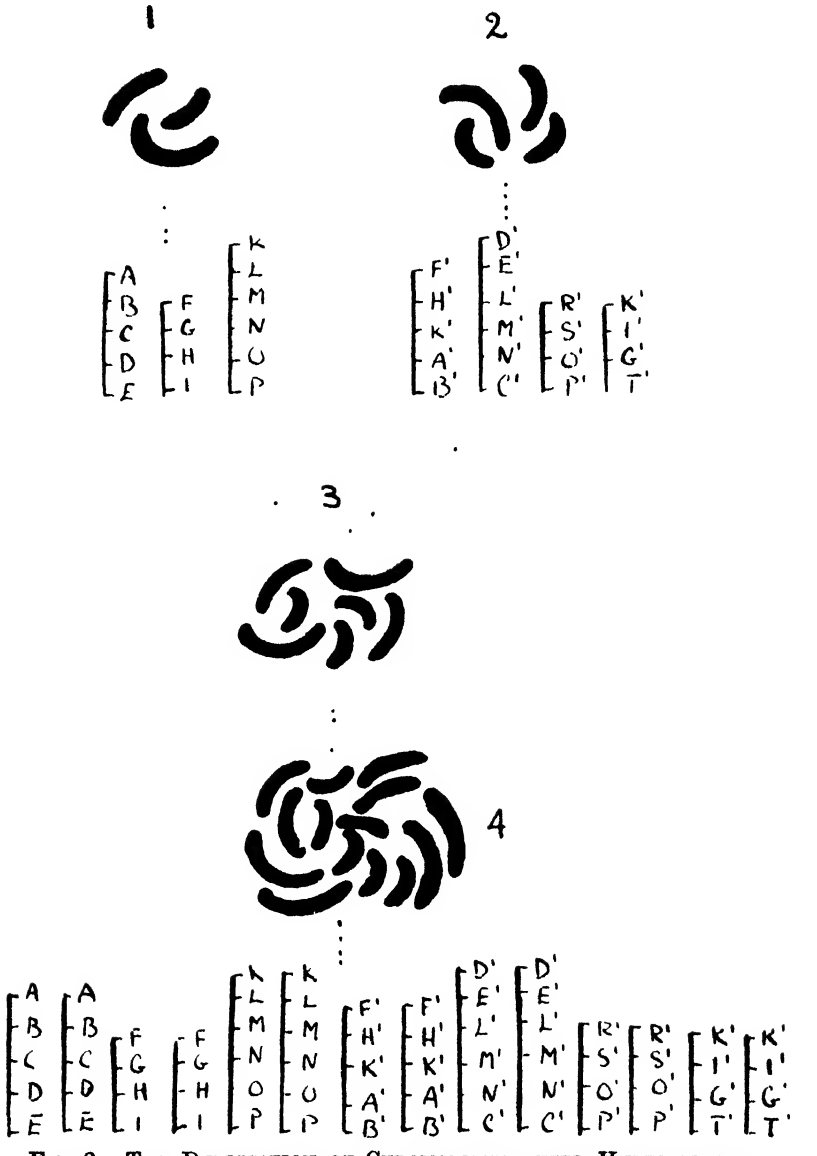


FIG. 2.—THE DUPLICATION OF CHROMOSOMES AFTER HYBRIDIZATION.

1 and 2 are germ cells of two distinct species with three and four chromosomes respectively. Similar letters in the maps denote similar genes in different relative positions. 3. A body cell of the hybrid with seven chromosomes, three from one parent and four from the other. 4. The new species with twice the number of chromosomes (fourteen) and map showing the increased genic complexity.

organisms slight changes, sometimes almost imperceptible, have gradually accumulated, and greater complexities of chromosome translocations and duplications have occurred, until the vast fabric of life as we know it has been built up.

Greatest achievement of all is the mind of Man. How much this is due to genic activity has yet to be proved, though recent evidence indicates that it is built up on the common genic foundation of all life (Hurst, 1932, B). From matter to life is but a short step bridged over by the formation of autocatalytic molecules, from life to mind is but another step, and to what fresh complexity may we look in the future? Already the mind of Man is beginning to take charge of the progress of evolution, human selection of species is replacing natural selection, even new species are being made experimentally. By means of X-rays the rate of gene and chromosome change can be so quickened that one may truly say that future progress lies in Man's own hands. The great problem of the present is how to improve the general intelligence of Man that he may be fitted for the enormous responsibilities put into his hands by the discoveries of science.

REFERENCES.

BABCOCK, E. B., and NAVASHIN, M., 1930: "*Crepis*," *Bibl. Gen.*, vi, p. 1.

DARLINGTON, C. D., and MOFFATT, A. A., 1930: "*Pyrus*," *J. Gen.*, xxii, p. 129.

HURST, C. C., 1932: (A) "Mechanism of Creative Evolution" (Cambridge Press).

HURST, C. C., 1932: (B) "Genetical Formula for Inheritance of Intelligence in Man," *Proc. Roy. Soc.*, B. 112, p. 80.

KARPETSCHENKO, G. D., 1929: "Three Species Hybrids," *Proc. U.S.S.R. Congr. Gen.*, ii, p. 277.

LJUNGDAHL, H., 1924: "*Papaver*," *Svensk. Bot. Tidsk.*, xviii, p. 279.

PATTERSON, J. T., and MULLER, H. J., 1930: "Progressive Mutations by X-rays," *Genetics*, xv, p. 495.

Received May, 1933.

THE ACCLIMATIZATION OF COTTONS IN NEW AREAS

THE Department of Agriculture, Uganda, have drawn attention to a statement made by Dr. Harland in his article on " The Acclimatization of Cottons in New Areas " (October, 1932, issue of the REVIEW) which appears to be somewhat misleading. The question was referred to Dr. Harland, and, the subject being of general interest, the correspondence from the Department of Agriculture and Dr. Harland's memorandum in reply are printed below.

The Director of Agriculture, Uganda, writes:

> " My attention has been drawn, as per the attached letter from Mr. Hosking, the Assistant Botanist, to a statement of Dr. Harland's that appears to be somewhat misleading. While there is no point in starting a controversy as to what is a ' modern standard variety of Upland Cotton,' you may care to send this on to Dr. Harland so as to give him an opportunity of restating what he has in mind in a way that is less confusing to growers of Upland cotton in Africa."

The Director further points out that the statement as it stands conveys the idea to the lay mind that all the efforts that have been so successfully made in Uganda to increase the production of cotton in that country have been wasted because they have been unable to grow a " modern standard variety of Upland cotton."

The Assistant Botanist's letter is as follows:

> " I have the honour to draw your attention to a statement which appears in the October, 1932, number of the EMPIRE COTTON GROWING REVIEW under S. C. Harland's name. The article in question is entitled ' The Acclimatization of Cottons in New Areas.' On p. 286, last paragraph, Dr. Harland states: ' The writer is at present not able to recollect a single case of success in the introduction of any modern standard variety of Upland cotton into Africa.' I do not know how such a statement can be made when one considers the position of Uganda. This year we have over one million acres under cultivation, all of which are under various types and mixtures of Upland cotton. The Eastern and Northern Provinces have approximately 750,000 acres planted with Nyasaland-Upland derivatives. Buganda and the Western Province have about 324,000 acres planted with a mixture of Sunflower, Allen, Black Rattler and other American varieties. Further, these areas have never received fresh seed since the first introduction of these types nearly a quarter of a century ago."

The following memorandum on the subject has been received from Dr. Harland:

> " It seems to me that there is some confusion about two things. The first is what is meant by a ' modern standard variety of

Upland,' and the second, what is meant by success so far as the introduction of cotton is concerned. The point I wished to stress in regard to modern standard varieties of Upland was that they do not exhibit the genetic diversity necessary for acclimatization in the tropics where climatic conditions are so different from those prevailing in the Southern States. The remarks I made about them do not apply with anything like the same force to the older varieties such as were widely distributed in the Southern States some twenty-five years ago. In my article I particularly discussed the position of cottons such as Allen and Nyasaland Upland, and pointed out that they constituted apparent exceptions to the statement.

" The Uganda cotton industry seems to be based on a mixture of Sunflower, Allen, Nyasaland Upland, and Black Rattler. Of these only Black Rattler is regarded in the Annual Reports as having been introduced direct from U.S.A. Nyasaland Upland and Sunflower are old introductions from other African colonies, and Nyasaland Upland is regarded as having originated in Africa, being selections from a mixture of several long-staple Upland types. Black Rattler, introduced direct from U.S.A., is an old introduction made before 1908. The introduction of the modern varieties, Meade, Kasch, Mebane, Acala and Bancroft, has resulted in failure. All these are modern varieties, and are known to be more uniform genetically than the varieties of twenty-five years ago.

" Success has been confined to older varieties which were apparently very mixed from the beginning, and therefore carried greater diversity than do modern Upland varieties.

" Black Rattler was initially a black-seeded cotton. As black seeds were removed by hand picking about 1905-1907 (Nye, *Ann. Rpt. Uganda Dpt. Agr.* 1931, Pt. I., p. 31), and as the Uganda group is, so far as can be ascertained, now composed of fuzzy-seeded cottons only, the contribution of Black Rattler to the present stock must have been largely derived from off types, and not from standard Black Rattler.

" These facts go to show that where some measure of success has attended the introduction of Upland cottons into tropical Africa the resulting strains cannot be regarded as standard varieties even if they are known by American names.

" It is necessary to specify more accurately what is meant by acclimatization. Biological acclimatization may be taken to mean that transference from one area to another results in little or no change in the reproductive activities of the plant. A careful study of the behaviour of Upland cotton in Uganda leads to the belief that even the varieties on which the industry is based are not properly acclimatized, as is shown by the enormous shedding due to physiological causes and the paramount place occupied by yield in the mind of the Cotton Botanist. It may also be noted that with a really acclimatized cotton increase in yield would be sought in increase in morphological characters bearing on yield, and not so much as at present in better physiological adaptation to enable the plant to realize the existing potential yield."

COTTON STATISTICS

INDIA

BY

JOHN A. TODD, M.A., B.L.

In recent years, in dealing with the season's history of the Indian crop, we have referred to the disappointing yield of the crop since 1925, which culminated in 1931–32, when the average yield was the lowest since 1920. As will be seen from Table I., the figures for the current season show only a moderate recovery from this low point, the estimated crop being 4,516,000 bales against 4,025,000. The acreage shows a further reduction of 5 per cent. from last year, but the average yield is only 80 lbs. per acre, and is therefore still the lowest since 1920, except 1931.

But this only serves to emphasize the discrepancy which has become increasingly serious again in recent years between the Government estimates and the figures of the Commercial crop which are given in detail in Table II. In order to bring out the position more clearly, we give below a comparison of the Government estimates and the Commercial crop since 1919–20, and to this we have added one of the most reliable of the private estimates—Ralli Bros. Taking the period of thirteen years, it will be seen that Ralli Bros. and the Commercial crop work out at almost exactly the same average, and that on this period the Government estimate showed a deficit of nearly 15 per cent. on the other two. For the current season the Commercial crop figures of course are not yet available, but the Government estimate is again less than 80 per cent. of Ralli's estimate. The result is that if we take Ralli's estimate for each crop the history of recent years is quite different from what is shown by the Government estimate. According to the latter, the crop has not touched 6,000,000 bales since their record figure of 6,215,000 in 1925, but according to Ralli's estimate the record was 6,948,000 bales in 1929, and the poor showing of the last two years is very much less marked than it is in the Government estimates.

INDIAN CROP: GOVERNMENT ESTIMATES *v.* COMMERCIAL CROP.

Season.	*Government Estimate.*	*Commercial Crop.*	*Ralli Bros.' Estimate.*
1919–20 ...	5,796	5,343	6,141
1920–21 ...	3,600	4,941	4,452
1921–22 ...	4,485	5,972	5,556
1922–23 ...	5,073	6,270	6,217
1923–24 ...	5,161	5,946	5,970
1924–25 ...	6,088	6,923	6,779
1925–26 ...	6,215	6,508	6,750
1926–27 ...	5,024	5,624	5,570
1927–28 ...	5,963	5,661	6,339
1928–29 ...	5,782	6,675	6,531
1929–30 ...	5,243	6,991	6,948
1930–31 ...	5,226	6,750	6,280
1931–32 ...	4,025	4,678	4,799
Averages ...	5,206	6,022	6,026
1932–33 ...	4,516	—	5,766

(000's *omitted.*)

According to the details given in Tables III. and IV. the comparative recovery of this year's crop has been almost entirely in the short-stapled districts and especially in the Oomras crop, which was, of course, the worst failure last year. The result is that the total production of $\frac{7}{8}$-inch staple and above shows very little increase on last year's figure, which means that throughout the whole of the four years shown in Table III. the production of long staple has been falling very far behind the earlier years both in total figure and percentage, for in 1925 there were 2,964,000 bales, or 43 per cent. of the total of $\frac{7}{8}$-inch and above, and in 1924 the percentage was even higher at 44·6 per cent., whereas this year the percentage is only 39·3.

These figures, however, must be taken with considerable reservation. We have, of course, always known that the grouping of the crop by varieties was very uncertain, but last year the Indian Central Cotton Committee published their distribution of the crop between short and long staple for season 1931–32, and their allocation showed (on the unrevised figures) only 1,320,000 bales long staple against 2,744,000 short. This means that they have transferred about 400,000 bales from long staple to short, which is accounted for by the fact that they put nearly the whole of Barsi and Nagar and about 20 per cent. of the Broach crop into short staple. Assuming that a similar correction would apply to the allocation this year, it means

again that fully 400,000 bales would be transferred from long to short, so that the long-staple crop would form only about 30 per cent. of the total. It would be a great advantage if the Indian Central Cotton Committee could publish their allocation in the same way every season.

It should be noted that for 1930–31 the total in Table III. does not tally exactly with the totals in the other tables. The reason is that in the Supplementary Report for this year the revision of the 1930–31 figures has only been given by Provinces but not by Varieties.

It only remains to add that the comparative recovery of the Oomras crop this year has at last begun to produce its effect on the relative prices of Indian and American cotton in Liverpool. In the last week of March, for the first time since November, 1931, the East Indian Futures contract in Liverpool dropped below 90 per cent. of the American Futures price, and in May it was down to 85 per cent. At the end of that month, however, it made a sudden recovery again to 90 per cent.

The Table of the other Empire crops which follows the Indian tables is compiled by the Empire Cotton Growing Corporation.

TABLE I.—INDIAN CROP, AREA, YIELD, AND PRICE, 1914–1932.

Seasons.	Area (Acres). 000's.	Crop (Bales of 400 Lbs.). 000's.	Yield per Acre. (Lbs.)	Net Exports and Consumption. 000's.	Season's Average Prices.	
					No. 1 Fine Oomra.	Per Cent. on American.
1914–15 ..	24,595	5,209	85	4,889	4·46	85
1915–16 ..	17,746	3,738	84	5,109	6·09	81
1916–17 ..	21,745	4,489	83	4,985	10·32	84
1917–18 ..	25,188	4,000	64	4,499	18·78	87
1918–19 ..	20,997	3,972	76	3,991	18·13	92
1919–20 ..	23,352	5,796	99	5,343	19·23	76
1920–21 ..	21,340	3,600	67	4,941	9·20	77
1921 22 ..	18,451	4,485	97	5,972	9·60	85
1922–23 ..	21,804	5,073	93	6,270	11·14	75
1923–24 ..	23,631	5,161	87	5,946	13 35	74
1924–25 ..	26,801	6,088	91	6,923	11·95	87
1925–26 ..	28,403	6,215	88	6,508	8·97	83
1926–27 ..	24,822	5,024	81	5,624	7·18	85
1927–28 ..	24,761	5,963	96	5,661	9 21	83
1928–29 ..	27,053	5,782	85	6,675	8 03	76
1929–30 ..	25,922	5,243	81	6 991	6·39	70
1930–31 ..	23,812	5 226	88	6,750	4·02	70
1931–32 ..	23,722	4 025	68	4,678	4 32	90
1932–33 ..	22,558	4,516	80	—	—	—

TABLE II.—INDIAN "COMMERCIAL" CROP.

(Running Bales 000's.)

Seasons.	Net Exports.	Mill Consumption.	Domestic Consumption.	Total.	Discrepancy from Government Estimate Per Cent.
1914-15 ..	2,118	1,771	1,000	4,889	– 6·2
1915-16 ..	2,486	1,873	750	5,109	+36·8
1916-17 ..	2,081	2,154	750	4,985	+11·0
1917-18 ..	1,705	2,044	750	4,499	+12·5
1918-19 ..	1,238	2,003	750	3,991	+ 0·5
1919-20 ..	2,680	1,913	750	5,343	– 7·8
1920-21 ..	2,113	2,078	750	4,941	+37·2
1921-22 ..	3,063	2,159	750	5,972	+33·2
1922-23 ..	3,411	2,109	750	6,270	+23·6
1923-24 ..	3,350	1,846	750	5,946*	+15·2
1924-25 ..	3,998	2,175	750	6,923	+13·7
1925-26 ..	3,775	1,983	750	6,508	+ 4·7
1926-27 ..	2,830	2,044	750	5,624	+11·9
1927-28 ..	3,140	1,771	750	5,661	– 5·1
1928-29 ..	3,933	1,992	750	6,675	+15·4
1929-30 ..	3,868	2,373	750	6,991	+33·3
1930-31 ..	3,729	2,271	750	6,750	+29·2
1931-32 ..	1,582	2,346	750	4,678	+16 2

* Up till 1923-24 the imports were deducted, because some of the mills in the Native States included foreign cotton in their consumption.

TABLE III.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY VARIETIES.*

Varieties.	1929–30.			1930–31.			1931–32.			1932–33.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
I. *Mainly under ⅞ Inch Staple:*												
Oomra (Khandeish, Central India, Berar, and Central Provinces)..	8,569	1,801	84	7,864	1,726	84	7,608	840	44	6,859	1,157	67
Dhollera	2,807	509	73	2,583	359	87	2,150	586	109	2,742	680	99
Bengal Sind (United Provinces, Rajputana, Sind, Punjab, etc.)..	3,604	977	108	3,360	989	118	3,295	764	93	2,801	771	110
Comilla, Burma, etc.	467	104	89	517	123	95	358	68	76	469	103	88
Coconada	259	45	69	199	32	64	186	33	71	193	28	58
Total under ⅞ inch staple ..	15,706	3,436	88	14,523	3,429	94	13,597	2,291	67	13,064	2,739	84
Per cent. of total crop	60·6	65·5	—	61·0	65·6	—	57·3	56·9	—	57·9	60·7	—
II. *Mainly ⅞ Inch Staple and Above*												
Punjab (American)	806	248	123	837	269	129	763	215	113	774	217	112
Sind (American)	27	8	119	65	20	123	59	14	95	98	32	131
Broach	1,324	284	86	1,232	277	90	1,271	274	86	1,278	309	97
Coompta Dharwar	1,746	284	65	1,356	178	53	1,665	248	60	1,405	223	63
Western and Northern	1,551	172	44	1,540	182	47	1,897	218	46	1,568	193	49
Tinnevelly	601	162	108	525	129	98	538	131	97	507	130	103
Salem	221	38	69	200	36	72	204	36	71	196	35	71
Cambodia	395	144	146	248	90	145	280	128	183	330	143	173
Barsi and Nagar	2,629	341	52	2,315	488	84	2,586	355	55	2,448	364	59
Hyderabad Gaorani	916	126	55	971	126	52	862	115	53	890	131	59
Total ⅞ inch staple and above ..	10,216	1,807	71	9,289	1,795	77	10,125	1,734	69	9,494	1,777	75
Per cent. of total crop	39·4	34·5	—	39·0	34·4	—	42·7	43·1	—	42·1	39·3	—
Grand total	25,922	5,243	81	23,812	5,224	88	23,722	4,025	68	22,558	4,516	80

000's omitted throughout in area and crop figures.

TABLE IV.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY PROVINCES.*

	1928–29.			1929–30.			1930–31.			1931–32.			1932–33.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.)*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
Madras	2,495	528	85	2,507	513	82	2,071	381	74	2,228	424	76	1,976	412	83
Mysore	76	23	121	69	9	52	72	10	56	83	9	43	88	10	45
Hyderabad	4,019	895	89	3,536	447	51	3,527	651	74	3,644	509	56	3,602	534	59
Bombay*	8,048	1,447	72	7,297	1,309	72	6,299	1,278	81	6,466	1,303	81	6,589	1,458	89
Baroda	793	69	35	771	127	66	731	140	77	693	136	78	722	144	80
Central Provinces and Berar	5,078	1,334	105	5,175	1,252	97	4,750	1,136	96	4,620	460	40	4,216	740	70
Central India ..	1,287	252	78	1,388	211	61	1,284	214	67	1,172	129	44	1,007	135	54
Gwalior	645	107	66	633	89	56	619	103	67	632	76	48	597	76	51
Bengal	79	18	91	78	21	108	77	19	99	75	17	91	76	24	126
Bihar and Orissa ..	78	14	72	69	13	75	69	14	81	68	14	82	65	13	80
United Provinces ..	715	255	143	929	289	124	845	324	153	753	207	110	527	170	129
Rajputana	476	123	103	507	67	53	520	73	56	437	62	57	419	57	54
Ajmer Merwara ..	44	21	191	34	11	129	31	11	142	27	11	163	33	11	133
Punjab	2,841	619	87	2,536	799	126	2,490	767	123	2,541	615	97	2,268	652	115
North-West Frontier..	17	4	94	17	4	94	13	3	92	18	4	89	16	3	75
Assam	44	17	155	41	15	146	41	15	146	37	15	162	37	15	162
Burma	318	56	70	335	67	80	373	57	93	228	34	60	320	62	78
Total	27,053	5,782	85	25,922	5,243	81	23,812	5,226	88	23,722	4,025	68	22,558	4,516	80

* Including Native States, also Sind and Delhi. 000's omitted throughout in area and crop figures.

EMPIRE COTTON CROPS FOR THE YEARS 1922–32, EXCLUDING INDIA.

(In bales of 400 lbs.)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Iraq, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

Country.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.
(1) Anglo-Egyptian Sudan	24,074	28,306	47,652	44,912	121,131	148,118	126,115	161.536	157.769	120,310	234,964 (1)
(2) Uganda ..	48,290	88,046	128,604	196,038	180,859	131,728	138,486	204,057	129.969	191,305	203,265 (2)
(3) Kenya ..	417	1,200	1,653	2,250	2,046	1,232	1,241	1,984	1.518	800	1,735 (3)
(4) Tanganyika ..	7,175	11,434	18,793	21,724	24,280	15,966	32,954	27,785	23.136	11,322	16,500 (4)
(5) Nyasaland ..	5,422	4,036	6,873	7,718	4,976	2,792	4,470	6.095	9.331	4.205	5,067 (5)
(6) N. Rhodesia ..	80	102	500	379	506	32	17	—	—	—	— (6)
(7) S. Rhodesia ..	—	—	1,650	4,907	6,803	639	90	280	1.481	1,974	579 (7)
(8) Union of South Africa and Swaziland	2,740	6,523	8,730	16,936	20,381	10,242	11,013	9.774	16.213	8,123	2,801 (8)
(9) Nigeria ..	15,096	16,811	25,694	39,137	47,909	27,464	20,930	32,126	43.925	18,850	6,268 (9)
(10) Gold Coast ..	49	15	93	1,132	1,218	285	264	296	200	297	263 (10)
(11) Cyprus ..	1,505	2,233	3,397	3,320	4,614	2,110	2,146	3.610	4.778	2,827	1,194 (11)
(12) Malta ..	193	118	573	782	507	342	541	379	293	201	41 (12)
(13) Iraq	300	1,100	2,400	2,540	3,500	1,800	5,200	4.700	3.300	960	409 (13)
(14) Ceylon ..	—	49	324	121	261	186	202	380	248	95	52 (14)
(15) Queensland ..	3,140	9,344	11,850	14,318	7,179	5,880	10,266	6,296	13,999	12,228	4,975 (15)
(16) Fiji	—	85	157	123	824	356	114	271	398	266	90 (16)
(17) West Indies ..	4,314	5,295	4,309	4,186	5,941	6,076	4,088	5.312	5,672	5,106	2,524 (17)
	112,795	174,697	263,252	360,523	432,935	355,248	358,137	464,881	412,230	378,869	480,727
		Percentage Increase 54·8.	*Percentage Increase* 50·6.	*Percentage Increase* 36·9.	*Percentage Increase* 20·0.	*Percentage Decrease* 17·9.	*Percentage Increase* 0·8.	*Percentage Increase* 29·8.	*Percentage Decrease* 11·3.	*Percentage Decrease* 8·1.	*Percentage Increase* 26·8.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

325. The following reports have recently been received:

Ann. Rpt. of Imperial Council of Agricultural Research, 1931-32.
Indian Central Cotton Committee: Ann. Rpt. for 1932.
AGRA AND OUDH: Rpt. on Admin. of Dpt. of Agr., 1932.
INDORE: Progress Rpt. of Inst. of Plant Industry, 1932.
PUNJAB: Rpt. of Operations of Dpt. of Agr., 1932, Pt. I.

326. REPORT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 1931-32. An account of the work of the year in connection with sugar, rice, hemp, oil-seeds, animal husbandry, and locust control. Cotton does not come under its direction.

327. INDIAN CENTRAL COTTON COMMITTEE. (*Ann. Rpt. to 31st August*, 1932.) A record of steady progress in the work of the Committee. The Cotton Transport Act and the Cotton Ginning and Pressing Factories Act continued to function satisfactorily. Further steps were taken to open regulated cotton markets in India. Forecast figures of the cotton crop were again posted by the Committee in Bombay simultaneously with their release at Calcutta, and the arrangement was greatly appreciated by the cotton trade. The fumigation of American cotton to prevent the introduction of the boll-weevil into India was continued, some 224,695 bales being fumigated as against 128,845 bales in 1931. During the year four of the Committee's research schemes were completed, three of them being those originally sanctioned in 1923. In all 29 research and other schemes were under operation, at a cost of Rs. 4,93,840. The work of the Technological Laboratory, Bombay, maintained its high standard, and the Indore Institute of Plant Industry successfully carried out its work as the centre of cotton research for the black cotton soil tract of Central India.

328. INDIAN CENTRAL COTTON COMMITTEE. At the 26th meeting held at Karachi on February 2-3, the following, among other important matters, were discussed: The working of the Central Provinces Cotton Market Act and the Madras Cotton Control Act; the adoption of common standards for Indian cotton in the Indian markets; the publication of cotton forecasts; the economic investigation into the cost of production of crops in the principal cotton and sugar-cane tracts of India; the effect of the Ottawa Agreement on the greater use of Indian cotton by Lancashire mills. The various research schemes financed by the Committee were reviewed, and several new schemes were sanctioned.

329. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notice:

"Cotton Research in the Punjab." Summarizes the work carried out at the Lyallpur Research Station during 1932. The effects of early and late waterings were investigated, and several new strains of American and *deshi* cottons were under trial. Important investigations were continued with a view to finding out the causes of the partial failures of Punjab-American cottons which have occurred periodically in the past. A detailed study of the reactions of the plant to various environmental factors was made. This included examinations of the moisture content of the soil, correlated with the speed with which water passes up the stem of the plant; the age of the leaves on the different portions of the

plant relative to their size; the carbohydrates in the various tissues of the plant body; and the size and weight of the bolls, as affected by conditions of growth.

330. Spinning Test Reports on Indian Cottons. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 88, 90-93, 95. 1932-33.) The circulars contain the grader's report and spinning-test results for Ujjain, Broach, Khandesh, C.P. No. 1, Berar, Latur, Nanded, Hubli Kumpta and Hubli Upland cottons for the 1932-33 season.

331. Technological Reports on Standard Indian Cottons. By N. Ahmad. (*Tech. Circs.*, Nos. 87, 89, and 94, 1932-33.) Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks and Conclusions.

1. *Verum* 262 (*Nagpur*).—Area under cultivation, 1931-32, 164,800 acres. With few exceptions the performance of this cotton has been fairly consistent. It gave poor results in 1929-30, but recovered in the following two seasons, though in the current season its performance is rather below the average. It is suitable for 23's warp.

2. *Punjab-American* 4 *F.*—Area under cultivation in 1931-32, 741,000 acres. The particular samples used in the tests were supplied by the British Cotton Growing Association, Khanewal, up to 1930-31, and by the Cotton Research Botanist, Lyallpur, in the following seasons. The Lyallpur cotton of 1932-33 is much superior to that of 1931-32, and has given stronger yarns than even the Khanewal samples. It is suitable for 25's warp.

3. *Surat* 1027 *A.L.F.*—Area under seed of known origin, 1931-32, 230,700 acres: the total area was considerably greater. The fibre properties and yarn characteristics remain the same as in previous seasons. The yarns are inclined to be somewhat neppy. The cotton is suitable for 31's warp.

332. Agra and Oudh. *Cotton Cultivation.* (*Rpt. on Admin. of Dpt. of Agr.*, 1932, recently received.) The departmental cotton varieties are C. 402, C. 520, and A. 19. The first-named has a ginning percentage of about 38 per cent. and staple equivalent to fine Broach, giving from 16 to 20 counts. It is, however, more delicate than the other two strains, and has met with little acceptance. C. 520 is a high yielding cotton of hardy character, giving counts of 10. It is distinctly superior in yield and quality to A. 19, the original short staple issued by the department, and still the most popular local cotton. It is being readily accepted, and appears to be the most desirable type for the Western cotton districts, where the chances of C. 402 making effective headway are small.

The research work in connection with pink bollworm was continued at Cawnpore. The field control work on this pest suffered from the necessary curtailment of funds, but at most of the centres there was a distinct reduction in the number of damaged bolls, and an increase in kapas.

333. Indore Institute of Plant Industry. Progress Report for the Year ending June 30, 1932. Briefly describes the research work in connection with cotton, sugar-cane, wheat, gram, linseed, and other crops. The rainfall during the year was abnormally high and continuous, so that the colloidal "blanket" formed was injurious to the cotton. The creation of an improved rain-fed cotton for the Malwa plateau is an important piece of work which was carried further; also work upon mutations caused by X-rays, and the relationship and reaction of the cotton plant to its environment in the black soils. The question of the deterioration of the black cotton soils through continuous rain was studied, with a view to arresting the trouble. Increasing the production of farmyard manure presents the easiest solution to the problem, and the technique

of the "Indore compost process" worked out at the Institute during the last three years provides the means without cost other than the cultivators' labour. This process is being actively adopted by large cultivators, and States are demonstrating its advantages in villages and on State farms.

334. PUNJAB. *Cotton Cultivation*, 1932. (*Rpt. of Operations of Dpt. of Agr.*, 1932, Pt. I.) The province now grows some three-quarters of a million acres of long staple cotton. Out of a total area of 2,159,772 acres under cotton in British districts during the year, no less than 1,234,493 acres were under improved types developed by the Department of Agriculture. The American variety 289 F. continued to give good outturns on good land well cultivated, and its lint fetched a premium over that of 4 F. Among Desi varieties, selected Mollisoni varieties continued popular in the canal colonies; the kapas of these fetched a premium of about annas 7 to 8 per maund over ordinary Desis. In the south-eastern part of the province M/60—A/2 and Rosea Bhatla were the varieties cultivated, some 167,000 acres of the former being grown, and 70,000 acres of the latter.

The cotton research work financed by the Indian Central Cotton Committee was continued during the year. It included selection work, varietal tests, and manurial, sowing date, and root development experiments. The investigations of white fly and pink bollworm were also continued with the assistance of the Committee. In addition, the Committee contributed towards the cost of a new ginnery for the Cotton Research Botanist; this will facilitate the ginning of pure strains for scientific and seed purposes.

335. SIND AND THE LLOYD BARRAGE, NO. 11. (Printed at the Govt. Cent. Press, Bombay, 1932. Price: R.1, Annas 2, or 1s. 11d.) In this edition, revised to December, 1932, the subject-matter, including the recommendations of the Reorganization Committee, has been brought up to date.

[*Cf.* Abstr. **84**, Vol. IX. of this REVIEW.]

336. TEMPERATURE, VENTILATION AND HUMIDIFICATION IN INDIAN TEXTILE MILLS: WITH REFERENCE TO WET KATA THERMOMETER COOLING POWERS. By T. W. Johnstone. (*Ind. Text. Jour.*, xliii., **511**, 1933, p. 249.)

337. LIST OF COTTON PRESSING FACTORIES WITH NAMES OF OWNERS AND PARTICULARS OF MARKS ALLOTTED TO THEM IN THE DIFFERENT PROVINCES OF BRITISH INDIA AND CERTAIN INDIAN STATES, FOR THE SEASON 1932-33. (Govt. of India Cent. Pub. Branch, Calcutta, 1933. Price R.1, Annas 8, or 2s. 6d.)

COTTON IN THE EMPIRE (EXCLUDING INDIA).

338. The following reports have recently been received:

Dept. of Scientific and Industrial Research; Rpt. for 1931-32.
BRITISH GUIANA: Div. Rpts. of Dpt. of Agr., 1931.
NIGERIA: Rpt. of the Agr. Dpt. for the year 1931.
NORTHERN RHODESIA: 2nd Ann. Bull. of Dpt. of Agr., 1932.
SOUTHERN RHODESIA: Rpt. of Secy. Dpt. of Agr. for 1932.
TANGANYIKA: Trade Rpt., 1932.
UGANDA: Ann. Rpt. of Dpt. of Agr., 1931, Pt. II.
WEST INDIES: *Barbados*. Agr. Jour. of Dpt. of Sci. and Agr., 1932.

339. BRITISH COTTON GROWING ASSOCIATION. The 28th Annual Report is of the usual interesting nature, and contains some good illustrations. Trading conditions throughout the year were extremely difficult on account of the disturbed political and economic factors prevailing. It is satisfactory to record, however,

that the quantity of cotton marketed by the Association showed an increase on the figures for recent years, 149,855 bales of a value of £1,976,243 being dealt with, compared with 121,362 bales of a value of £1,338,657 in the previous year. During the period under review the value of materials supplied by the Engineering and Stores Dept. to planters, ginners, and others engaged in the cultivation and ginning of cotton, amounted to £26,660, as compared with £20,329 in 1931. The work of the Association in the Colonies is described, and useful statistical appendices are included.

340. Report of Department of Scientific and Industrial Research, 1931-32. (Cmd. 4254. Pubd. H.M. Stat. Off., 1933. Price 3s. net.) The 17th Annual Report contains a general review of the work carried out under the supervision of the Boards and Committees of the Department, together with a section describing the work of Research Associations.

The work of the British Cotton Industry Research Association in connection with the opening and cleaning of cotton has made great progress, and it is not too much to say that research results now being obtained may soon lead to revolutionary ideas which will greatly increase the efficiency of opening and cleaning machinery. The spinning plant in the new machinery building has continued to be of great service in the investigation of new cottons, new machinery, and variations in methods of processing. A large number of spinning tests have again been made on selected varieties of cotton produced by the Empire Cotton Growing Corporation; the value of these tests to cotton breeders when deciding what types to develop cannot be overrated. Other investigations carried out during the year include: the testing of new machines which may prove of value to the industry, such as the recently invented inclined Spindle Ring Frame; a searching investigation into the mechanism of the Lancashire loom with the object of improving its efficiency; study of dyestuff solutions; the effects of bleaching on the dyeing qualities of cotton cloth; and examination of various factors in the process of mercerization that influence the dyeing qualities of the mercerized material, etc.

In connection with fabrics research, the report states that the research workers concerned in the investigation into the destruction of fabrics by micro-organisms, having completed their review of the results obtained from the exposure of fabrics at various stations, have now commenced on a physiological study of the destructive types of micro-organisms found on the fabrics. The research at the Royal Aircraft Establishment on the development of a "permanent" method of fireproofing fabrics has recently been completed, while the work at the national Physical Laboratory on the action of sunlight on cotton was concluded in March last. A report describing the results of these researches is now in course of preparation with a view to publication.

341. Empire Cotton Crops. Production and Consumption. By J. A. Todd. (*The Times Trade and Eng. Supplt.*, May 20, 1933.) In discussing the position and progress of Empire cotton, from the point of view of both production and consumption, the author states that it is necessary always to bear in mind that Empire cotton is merely one factor, and rather a small one, in the total volume of the world's production and consumption of cotton. Its importance, however, is much greater than its volume indicates. In the old days the cotton world was more or less divided into a series of watertight compartments, such as Egyptian, American, and Indian, and there was not much overlapping or substitution of these different growths in the spinning trade. But all that has changed in recent years, and the change has been to quite a considerable extent the result of the development of the Empire supplies.

342. AFRICA: Gold Coast. *Cotton Cultivation.* (*Bull. of Imp. Inst.*, xxxi., 1, 1933, p. 92.) Work has been concentrated on the locally bred strain D. 28—a type of American Upland origin—since this is likely to prove the most useful type for distribution. One of the secrets of the success of this type is that it flowers in the dry season, rather than during the rains, and thereby the loss due to flower and boll shedding is minimized. The following data relating to the best of the various strains under trial serve to show the outstanding merit of D. 28:

Strain.	*Seed-cotton Yields per Acre.*
D. 28 (in rotation)	280 lb.
D. 28 (no rotation)...	204 ,,
Coconadas	189 ,,
Karangani	83 ,,

The yield of 200-300 lb. per acre now attained is the level at which cotton-growing in the Northern Territories would pay under ordinary normal conditions, but at present slump prices no cotton would yield sufficient to cover transport and other expenses from Tamale. The possibility of a revival in values, and the local demand for domestic purposes, warrant a continuance of work on the D. 28 strain with the object of further improvement and distribution to local farmers.

343. Nigeria. *Cotton Cultivation.* (*Half-yearly Rpt. of Dpt. of Agr. to March* 31, 1933.) *Northern Provinces.*—The purchases this season, estimated at 21,820 bales of 400 lb., are slightly above the average of those of the previous ten years. The exports for 1932-33 have been appreciably exceeded only by the bumper crops of 1925-26 and 1929-30. The ratio of the number of bales bought this season per ton of seed distributed is 13·4; this is the highest on record, and is a trustworthy indication that the popularity of cotton has been re-established, for it means that practically every pound of seed distributed must have been carefully planted. The desire to grow as large an acreage of cotton as possible was the direct result of the slump in food prices, due to over-production. In addition, the obvious reduction of the locust menace rendered unlikely any serious shortage of food in the near future.

A drought during the middle and end of July affected almost the whole of the cotton-growing area, and consequently much of the cotton was planted late. As the result of heavy late rains, however, good returns were obtained even from the late planted cotton. The average yield per acre over the whole of the area was rather above average, and at the experimental farms was high—at Samuru 93, at Kano 74, and at Maigana 80 lb. per acre above the average for all previous seasons.

The quality of the crop in Zaria and Southern Katsina was satisfactory, but in Sokoto and in north and mid-Katsina was disappointing. Colour was good everywhere, and little stained cotton was seen.

The season opened with a basic price of 0·9d. per lb. at Zaria and other railway stations, but at Gusau, owing to lower ginning outturn, it was 0·1d. less. The conduct of the markets was uniformly good, and there were practically no complaints. Several additional markets will have to be opened next season.

It is expected that some 2,240 tons of seed will be distributed, and the demand is probably as keen as at any time since cotton-growing became really established in the North. Twenty-two tons of Strain L. seed will be distributed in the six village areas in the immediate vicinity of Dan Ja.

Southern Provinces.—Only 1,300 bales of Ishan cotton were exported in 1931-32, this being due to the low prices ruling. It is anticipated that the same

quantity will be exported in 1932-33. The weather during the planting and growing season was quite abnormally dry—in fact, it was the driest season experienced for thirty-five years. There was one timely rain, and farmers who missed the first opportunity to plant cotton lost their only chance. Had the weather been normal, there would probably have been considerably more cotton grown. There seems every reason to suppose that given even a slight improvement in the price of cotton for export this crop will become a more important crop in Southern Nigeria than it has ever been before.

The multiplication of selected seed of the present strain "Ishan A" is being continued. The cotton breeder is also continuing his work of selection among the artificial crosses of the hardy high-yielding strain "A" with less hardy strains of higher quality, both of Ishan cotton and of Sea Island (the latter supplied by Dr. Harland from Trinidad).

344. *Cotton Cultivation in the Southern Provinces*, 1932-33. (*Bull. of Imp. Inst.*, xxxi., 1, 1933, p. 92.) According to a report by Mr. E. H. G. Smith, of the Botanical Section, Southern Provinces, the present season promises to be a very satisfactory one, and compared with that of 1931-32, the incidence of the common Nigerian cotton pests and diseases has been markedly less on the resistant strains. The five New Guinea Kidney by Sea Island (cross) strains introduced from Fiji, have not proved suitable to Ibadan conditions. The leaves of all plants of these strains were found to be almost completely glabrous, and from about one month before the beginning of flowering until the cessation of the rains all plants were severely affected by jassid (*Empoasca facialis*). This pest is only of importance at Ibadan when attempts are made to grow susceptible cotton strains. Flowering on the Fiji plants was poor, and boll shedding was severe, with the result that very few bolls will mature.

345. NYASALAND. *Cotton Cultivation.* (H.M. East Afr. Deps. Trade and Inform. Off.) A report for the month of March states that seed issues to date in the Blantyre, Central Shiré and Lower River areas total 891,363 lb. to 45,000 native growers. In 1932, 425,600 lb. of seed were issued to 13,000 growers.

346. NORTHERN RHODESIA. We have received a copy of the *Second Ann. Bull. of the Agr. Dept., N. Rhod.*, 1932, containing the following among other interesting articles: "Notes on Fertilizer Trials, 1928-32" (T. McEwen), showing the effects on maize yields of various applications of artificial fertilizers; "The Movement and Breeding of Locust Swarm (July, 1931, to September, 1932)," (W. Allan), dealing with the history of the swarming of the Red Locust and the Migratory Locust, and indicating briefly certain aspects of life history and habits in relation to the course of the invasion, and the probable direction of future movements; "Native Agriculture in the Abercorn District" (U. J. Moffat), a comparison of two methods of agriculture practised by the natives in the district—the "Chitemene" or tree-cutting system, and the "Mambwe" or green manure and fallow system. The importance is stressed of a careful examination of long-established native systems of agriculture before attempts are made to improve them.

347. *Cotton Investigations*, 1931-32. (*Ann. Rpt. of Emp. Cott. Grow. Corpn.*, 1933.) The experimental work has been mainly directed towards the study of American bollworm and stainers, which are the present limiting factors in establishing cotton as a commercial crop. An investigation into the reaction of various strains of U. 4 to differing soil conditions is being undertaken. This matter is of importance as the influence of soil conditions appears to affect the incidence of the stainer through the habit of the plant. In addition, an assessment of the damage caused by bollworm and stainer is being made, and the period

during which maximum damage occurs determined. In the present season seed has been issued to seven farmers, who have kindly agreed to co-operate by establishing observation plots. Seed has also been supplied for 75 acres to be cultivated for the recognized rotational benefit of the cotton plant on local soils and for winter feed.

348. Southern Rhodesia. *Cotton Cultivation*, 1931-32. (*Rpt. of Secy. Dpt. of Agr.*, 1932.) The season favoured early planting and germination was good, but the prolonged autumn rains caused a continuance of humid conditions with a consequent increase in cotton pests, particularly jassid and stainer. These, combined with delayed ripening, resulted in a bad opening of bolls generally. The occurrence of internal boll disease appeared worse than in previous years, and the Cotton Specialist fears that this may have an injurious effect on the seed available for the present planting season.

In connection with the Cotton Breeding Station, Gatooma, the season was the best experienced since its inception seven years ago. Jassid attack was the most severe on record, but this was welcomed, since it offered material assistance in facilitating the rejection of strains and selections which otherwise might have been carried on for further observation. In regard to selection work, Mr. Cameron states that more than one-half of this year's selections were derivatives of the U. 4/64 strain, and one of the most promising of these, U. 4/64/V, has been issued to selected growers for further bulking in the present season.

It would appear that some farmers in Rhodesia are beginning to realize that even at to-day's low prices cotton can still be made a paying crop. In certain outlying districts where hitherto maize has been the staple crop, it is now impossible to produce this grain profitably, and an alternative crop is necessary. Thus far there appears only one in sight—namely, cotton. In this connection it is suggested that the time may be ripe for reviewing the feasibility or otherwise of encouraging native production of cotton, several of the Native Reserves being situated in areas which should be well suited for this crop.

349. Tanganyika. *Cotton Cultivation*, 1933. (*Crown Colonist*, June, 1933.) Owing to the shortage of rain throughout the Eastern Province during March and part of April, the first sowings of cotton seed did not germinate. Fortunately, fresh supplies of seed were available for distribution, but more rain is needed.

350. *Cotton Prospects*, 1933. The latest report from the Department of Agriculture is to the effect that cotton in most districts of the Eastern Province is doing well. In Kilosa cotton seed distribution to natives was nearly double that of last year, and non-native planters have increased their acreage.

351. Uganda. *Cotton Cultivation*, 1931-32. (*Ann. Rpt. of Empire Cott. Grow. Corpn.*, 1933.) The year was noteworthy for the fact that the pink bollworm made its appearance in Uganda for the first time, and notwithstanding immediate steps being taken to retard its spread, a considerable part of the Northern Province was infested.

In the Eastern Province, the selected strain of cotton known as S.G. 29 was grown on about 55,000 acres, and it is intended to spread this strain gradually over the whole Province. This season three segregated areas, comprising about 30,000 acres, have been declared in the Teso district, with a view to safeguarding the multiplication of new varieties prior to their general distribution.

The botanical work in Buganda has included selection for resistance to blackarm disease; two strains have been produced which show definite resistance, but neither is a high yielder, and work is being continued with a view to improving this property without impairing the power of resistance to blackarm.

352. *Cotton Reports*, 1931-32. (*Ann. Rpt. of Dpt. of Agr.*, 1931, Pt. II.) From the report of the Senior Agricultural Officer we learn that the weather at Serere was generally unfavourable for cotton. Spacing experiments were conducted at Serere, Ngetta, and at two centres in Busoga, and in every case 3×1 ft. spacing gave higher yields than 4×1¼ ft. Ratooning of cotton was found to be undesirable, since the yield was low and the lint of poor quality.

The Cotton Botanist, Bukalasa zone, states that the weather, as at Serere, was unfavourable for cotton. Angular leafspot spread rather more slowly than last season, but blackarm was more in evidence, and in addition *Lygus* caused considerable loss of crop on old land. The most promising of the new cotton selections were re-selections from the B. 31 and B. 39 groups, which were markedly resistant to angular leafspot and to blackarm. Attempts will be made to improve the yield of these strains, which at present is rather poor. In the pedigree lines a U.4.4.2 selection showed high resistance to angular leafspot and blackarm coupled with good yielding powers. In the varietal trials a most encouraging feature was the behaviour of S.G. 23.8. This strain recovered from a heavy attack of angular leafspot and blackarm and yielded well; in addition it possesses better spinning qualities than any other variety experimented with in the country.

The Assistant Cotton Botanist reports from the Serere zone that the most serious pests and diseases encountered during the season were blackarm, jassids, *Helopeltis bergrothi*, and stainers. The new selection strains originating from S.G. 129 were again the most successful in regard to yield and resistance to blackarm. In the pedigree lines, S.P. 13, a reselection from Parnell's U.4.4.2, gave the best yield, and showed the highest resistance to jassid.

In the report of the Entomologist it is stated that the outstanding features of the year were the extensive invasion and breeding by the hairy-chested locust and the discovery of the pink bollworm in the Gulu district of the Northern Province. The locust menace was the main preoccupation of the section during the first half of the year. The pink bollworm was discovered during December in the Madi area on both sides of the Nile, and the Assistant Entomologist immediately proceeded to determine the limits of spread from the Sudan to the south and east.

The Mycologist reports that on the whole blackarm disease was not exceptionally severe during the season. Sore-shin disease gave trouble in some plots, and *Diplodia theobromæ* caused considerable damage in Buganda Province. Staining of cotton by *Nematospora gossypii* was rather more severe than usual.

353. *Cotton Industry*, 1932-33. (Reports received from H.M. East Afr. Trade and Informn. Office, February-March, 1933.) Owing to the abnormally heavy rains experienced at the end of January and beginning of February a certain amount of damage and loss of crop was caused in Buganda, and the official estimate of a total yield of cotton for the Protectorate of 275,000 bales of 400 lb. each, was reduced to 260,000 bales, easily a record for the country. The average price paid for the crop will be lower than last season, due mainly to the reduction of premium on the Bombay market.

Ginneries.—To date 132 ginneries out of 194 erected ginneries have been licensed to gin and bale the crop, as compared with 123 in 1932. Very few sales of ginneries have taken place this season, since available offers are too low to attract sellers.

Legislation.—The Cotton Ordinance, 1926, has been amended to make it illegal for purchases of raw cotton to be made otherwise than for cash, to be paid in full on delivery of the cotton to the purchaser.

354. *Cotton Industry*, 1932-33. (*Crown Colonist*, vol. iii., 17, April, 1933.) From this report we quote the following: "We are now well into the cotton season,

and everybody is working at full pressure. The crop is a record one. Arrivals were slow to begin, but have been extremely heavy lately. The price on offer is 9s. to 10s. per 100 lb., and is about as high as can possibly be paid in the low state of the world's markets. The quality of the cotton is good throughout. Prices for first-class ginned cotton are: Kampala 40 cents per lb.; Busoga, 39 cents; Bukedi, 38 cents; and Lango and Teso, 37½ cents. A crop of at least 260,000 bales will now be harvested. Trade is brisk in the bazaars, and money is circulating freely. There will be over two millions in hard cash paid out during the next few weeks, and the majority of this soon finds its way back to the bazaars. Indenting has been going on since December on a fair scale. . . . Commercial travellers are experiencing a good time, and the representative of United Exporters stated that February has been the best month for the last three years."

355. WEST INDIES: BARBADOS. *Cotton Spacing Experiment.* (*Agr. Jour. of Sci. and Agr., Barbados*, i., 3, 1932.) The object of the experiment was to test the effect of two spacing distances on the yield and time of yield of seed cotton. The spacings employed were (1) rows 5 feet apart, two plants at every 20 inches in the rows, and (2) two rows 2 feet apart, space of 3 feet; then two rows 2 feet apart, etc.; two plants at every 20 inches in the rows. The conclusions drawn from the experiment are that the closer spacing increases the yield of seed cotton per acre, and that in a year favouring the cotton crop the closer spacing hastens the maturity of the cotton.

356. ST. KITTS-NEVIS. *Cotton Cultivation.* (*W. Ind. Comm. Circ.*, xlviii., **904**, p. 210.) The market for Sea Island continues to be unsatisfactory, and the area under cultivation has been considerably reduced. In 1932 only 85,000 lb. of lint were produced, the crop being severely damaged by pink bollworm. A Cotton Growers' Association, recently formed, will, it is hoped, combine with similar associations throughout the West Indies in an effort to secure better marketing conditions.

357. ST. VINCENT. *Cotton Cess.* (*West Ind. Comm. Circ.*, xlviii., **902**, 1933, p. 168.) An Ordinance has been passed increasing the export duty on Sea Island cotton, in order to provide for the island's subscription to the West Indian Cotton Growers' Association. A special duty of one halfpenny per lb., which is to be additional to the duty chargeable already under the Export Duties Ordinance of October last year, will be levied for this purpose.

358. IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD. The Principal's Report for 1931-32 deals with the varied activities of the College, and the work in connection with the four main crops of economic importance—viz., cacao, sugar-cane, bananas, and citrus—is described. The Cacao Research scheme is financed by a grant from the cacao-producing colonies and certain prominent cocoa and chocolate manufacturers in England. The Banana Research scheme is likewise separately financed by a grant from the Empire Marketing Board.

The Principal states that the financial position of the College caused considerable anxiety during the year, since owing to the economic depression, contributions from the usual sources were in some cases curtailed, and in a few instances ceased. The enforcement of the strictest economy resulted in considerable saving, but it meant that the work of the various departments could not expand in any direction. A much appreciated contribution to the cost of maintenance was made by the members of the staff, who voluntarily offered a portion of their salaries as a practical gesture of assistance towards meeting the unprecedented situation that arose when the United Kingdom went off the gold standard. A third matter that helped to relieve the situation was the receipt,

under certain conditions, of a generous endowment of £32,000 by the Carnegie Corporation. These unforeseen additional sources of revenue enabled the budget to be balanced, but the strictest economy will have to be continued, and no expansion whatever can be undertaken, unless further sources of revenue are forthcoming. It is sincerely hoped that with the arrival of better times the opportunity will be taken to augment the Endowment Fund that has been opened so auspiciously.

COTTON IN EGYPT.

359. EGYPT. *Cotton Cultivation*, 1933. (*Int. Rev. Agr.*, Rome, xxiv., 3, 1933, S. 176.) Cotton planting commenced in the second week in February, a week earlier than last year. It is anticipated that the maximum permitted by the law will be sown, since the areas destined to cereals and sugar-cane show a considerable decrease. The weather so far has been very favourable.

360. EGYPTIAN COTTON INDUSTRY: ITS CLOSE RELATIONSHIP WITH LANCASHIRE. By N. S. Pearse. (*Financial Times*, February 27, 1933.) An interesting review of the prospects of the Egyptian cotton industry in the present year. The author is of opinion that, notwithstanding the difficulties—economic, financial, and industrial—that still abound in the world, there are signs of a slight improvement in the outlook in the cotton industry in general, and in any improvement the Egyptian cotton industry must have a part.

361. DEVELOPMENTS IN COTTON CULTIVATION: SAKEL AND ITS SEED SUPPLY. By W. L. Balls. (Egyptian Cotton Number, *Man. Guar. Coml.*, March 25, 1933.) Researches are going on upon soil fertility and its deterioration by waterlogging. A practical inference from these researches, which is a safe one even in their present incomplete form, is that the importance of local drainage applied to individual acres has previously been underestimated. An available method of tile-drainage suited to Egyptian soil conditions is consequently attracting more and more attention, while it may also be found worth while to attack the problem from the other end by preventing ingress of water. This would mean enormous expenditure on the lining of high-level canals, which has previously been considered uneconomic for Egypt, and much more knowledge of the chemical and biological machinery of deterioration must be acquired before such expenditure can be confidently recommended as a business proposition of the nature of insurance against future extensions of deterioration.

In the actual cultivation of cotton there have been notable improvements, which take the form of adapting the operations of the grower to the new conditions brought about by the pink bollworm. The ordinary cultivator has been feeling his way in the same direction by small changes from year to year, but the experimental investigators have been able to get there in one jump. Essentially the change consists in trying so to cultivate the crop that as many as possible of the early flower-buds ripen into bolls. The three chief methods available for doing this, without appreciable additional cost to the grower, are sand-sowing, early watering, and close spacing.

Occasional complaints are still heard about the quality of Sakel, which is said—as usual—to be depreciating on account of carelessness with its seed. Now it happens to be the case, on the evidence of spinning tests and seed control statistics, that not only the basal seed supply of Sakel is better than it has ever been in the past, but that a far larger percentage of this good seed reaches the smallest growers. The seed sold for crushing to-day is far better sowing-seed than was used for planting five years ago. The explanation of any inferiority

in quality, therefore, can only be ascribed to inferior cultivation, due to the low prices obtaining during the crisis.

The position of Uppers is now quite satisfactory. In the early years of the operation of the seed control law there was an extensive development of fraudulent practices (by means of false sampling) in Upper Egypt. In one district this was carried so far that the seed was made worse by the law, instead of better. Moreover, the practice was beginning to spread to the Delta, where two years of honest working were succeeded by fraud, but then by detection and remedy. In Upper Egypt the position was much worse, but counter-inspection, statistical study, and the construction of a secret black list, have effected a cure; seed containing 1 per cent. of Hindi contamination is now rare.

362. Egyptian Cotton Number. (*Man. Guar. Coml.*, March 25, 1933.) A very interesting number dealing with Egyptian affairs, containing the following articles in connection with cotton: "Broadening the Market for Egyptian Cotton: A Campaign in Many Lands," by H. E. Ahmed Wahab Pasha. "A Suggestion for Egypt's Cotton Growers," by L. Haselden. The suggestion is that Egypt should set herself to produce a cotton such as Tanguis—which is suitable for spinning hosiery yarns—and thus secure for herself a share of a growing market. "The Wearer's Point of View: Garments of Egyptian Cotton," by K. V. Tranter.

363. The Nile Basin. II. By H. E. Hurst and P. Phillips. (*Phys. Dpt., Paper No.* 28, *Min. of Public Works, Egypt*, 1932. Govt. Press, Cairo. Price P.T. 50.) A complete list of the measured discharges of the Nile and its tributaries.

[*Cf.* Abstr. 115, Vol. IX. of this Review.)

COTTON IN THE UNITED STATES.

364. The Agricultural Outlook for 1933. (*U.S. Dpt. of Agr. Misc. Pubn., No.* 156, February, 1933.) *Cotton.*—Domestic mill consumption from September to December, 1932, was materially above that in the like period for the two previous years. Despite the high rate of production, textile stocks at the end of 1932 were much lower than at the end of any of the previous five years. The estimated world consumption of American cotton during the first four months of the present season was 11 per cent. above that in the corresponding period of 1931-32. Prices of American cotton remained fairly stable from mid-October to late January, and although substantially below the level reached in late August, they were, at the end of January, about 1¼ cents above the low point of June, 1932.

The acreage planted to cotton in 1933 will depend largely on farmers' decisions on the quantity of food and feed crops they can use or dispose of advantageously in 1933-34. In most sections farmers have large supplies of home-grown food and feed, but the increase in the number of cattle and hogs in the South during last year has increased feed requirements. Labour, fertilizer, and some other production costs are lower than in the spring of 1932. Prices of most alternative crops are also lower than they were a year ago.

Boll weevils entered hibernation in large numbers, and were more generally distributed over the Cotton Belt in the fall of 1932 than for several years. Weevil damage, therefore, may be unusually heavy in 1933 should weather conditions be favourable to their development. In view of low incomes, farmers are not likely to spend much money in combating them.

365. American Cotton: Production and Consumption Statistics. (Reprint No. 1250 from *U.S. Dpt. Agr. Yearbook*, 1932. Abstr. from *Summ. of Curr. Lit.*, xiii., 7, 1933, p. 192.) Figures are given for acreage, production, value, exports,

prices, domestic consumption, etc., of American cotton in various periods since 1849, and for production, acreage, etc., in specified countries in various periods since 1909.

366. AMERICAN COTTON: UNIFORMITY. By O. F. Cook. (Reprint No. 1282 from *U.S. Dpt. Agr. Yearbook of Agr.*, 1932. Abstr. from *Summ. of Curr. Lit.*, xiii., 7, 1933, p. 158.) The deterioration of cotton varieties by cross-pollination and by mixing of seed at public gins is discussed, and the need for selective breeding and careful preservation of the uniformity of seed stocks is emphasized. In order to produce uniform cotton a district should limit itself to a single superior variety. A better buying system with more discrimination in the quality and price of cotton in primary markets would encourage improvements in uniformity.

367. GEOGRAPHIC DISTRIBUTION OF STAPLE LENGTHS OF AMERICAN UPLAND COTTON CROPS of 1928, 1929, and 1930. By W. B. Lanham. (*Int. Cott. Bull.*, xi., 43, 1933, p. 354.) Data are presented showing for the three consecutive years the number of bales of each staple length of American Upland cotton ginned in the United States and in each of the cotton-producing states.

368. AMERICAN COTTON SPINNING INDUSTRY: COMPETITION. By E. G. Field. (*Cotton* [U.S.], 96, No. 12, 1932, p. 32. Abstr. from *Summ. of Curr. Lit.*, xiii., 4, 1933, p. 97.) The writer seeks to show the evils of over-competition in the American cotton industry, and urges co-operation between mills. Some statistics relating to "active spindles" are given.

369. COTTON: SELECTION. Southern Textile Association. (*Cotton* [U.S.], 97, No. 1, 1933, p. 34. Abstr. from *Jour. of Text. Inst.*, xxiv., 4, 1933, A. 218.) Discusses the essential characteristics of cotton in relation to different fabrics, the selection of cotton for different types of fabrics, differences between cottons from different districts, and changes in carding and spinning required for the treatment of the new crop cotton.

370. AMERICAN TEXTILE NOTES. By W. Whittam. (*Text. Rec.*, L. 600, 1933, p. 66.) *Proposed Duty on Cotton.*—A discussion of the proposed duty of 5 cents per pound on all cotton used by American manufacturers for the production of articles for consumption in the home market. The moneys thus collected would be paid by the Government to the cotton growers who reduce their acreage by a percentage to be determined from season to season by the U.S. Secretary of Agriculture. With the exception of certain cotton-growing groups, the plan is condemned by virtually every branch of the textile trades.

371. CONDITIONS IN THE U.S. TEXTILE INDUSTRY. By W. Whittam. (*Text. Rec.*, L. 601, 1933, p. 68.) Deals with President Roosevelt's recommendations as to farm relief, which include cotton as a chief item.

372. COTTON YEARBOOK OF THE NEW YORK COTTON EXCHANGE. By Alston H. Garside. (*Int. Rev. Agr.*, Rome, xxiv., 2, 1933, T. 100.) Presents in an easily comprehensible manner statistics concerning world production and the distribution of United States and other cotton plantations, as well as other interesting information on the cotton market.

373. SEA ISLAND COTTON: CULTIVATION. By C. B. Doyle. (Reprint No. 1283 from *U.S. Dpt. Agr. Yearbook of Agr.*, 1932. Abstr. from *Summ. of Curr. Lit.*, xiii., 7, 1933, p. 159.) The annual production of Sea Island cotton in the South-Eastern States formerly amounted to about 90,000 bales, but production declined after the invasion of the boll weevil, and was practically abandoned about ten years ago. Commercial planting of Sea Island cotton is now confined almost entirely to Porto Rico and other islands of the West Indies. The present total

annual production is less than 10,000 bales, and practically all of this crop represents fancy grades with staples 1¼ inches long and upwards. Experimental plantings over a period of more than ten years have shown that Sea Island cotton cannot be successfully grown under the old system of mixed variety planting with Upland cotton; the only possibility of successful production under present conditions is in communities or districts devoted entirely to the planting of Sea Island cotton to the complete exclusion of any other variety or type. In the absence of supplies of Sea Island cotton, the American market for this cotton completely disappeared several years ago, and farmers are being advised not to plant Sea Island cotton on a large scale anywhere in the continental United States at present.

374. ARKANSAS. *Relation of Grade and Staple Length of Cotton to Prices received by Farmers in Local Markets.* By J. G. Maddox. (*Ark. Sta. Bull.* 274, 1932. Abstr. from *Exp. Sta. Rec.*, **68**, No. 1, 1933, p. 117.) A report of a three-year study carried out in co-operation with the Bureau of Agricultural Economics, U.S.D.A. It is stated that, though prices paid by mills bear a rather definite relation to grades and staples, no such relationship is found between price and quality in the local or farmers' markets; that on a given day in a local market, "growers received little if any higher prices for cotton of high grade and long staple length than for relatively low grade cotton of short staple." Factors indicated as influencing the prices paid to farmers include differences in classification as practised by Government classers and local buyers, and weaknesses of farmers' bargaining power. Local buyers are more dexterous bargainers than the farmers from whom they buy cotton. The bargaining power of the growers is strengthened when their cotton is sold on the basis of Government standards, as in the case of co-operative marketing. Local marketing practices may be improved, and the bargaining power of growers strengthened by technological researches designed to determine more tangible and definitely described standards of quality, by giving the farmers the benefit of a better classification service, and by improving their general knowledge of cotton quality in relation to prices.

375. CALIFORNIA. *Cotton Cultivation.* (*S. Calif. Crops*, ix., **4**, 1933.) It is estimated that cotton planting will be increased, since farmers believe that even at present price levels cotton is more capable of meeting carrying charges than any other field crop.

376. GEORGIA. *Cotton Experiments*, 1932. (*Ann. Rpt. of Exp. Sta. Ga.*, 1932.) In various experiments conducted at the Station, Stoneville 2 cotton was outstanding in its ability to produce a good stand under a wide range of planting conditions, and to germinate at low temperatures in the germinator. This variety was also very successful at the one-variety centre at Orchard Hill, farmers receiving from $3-5 per bale more for it than for ⅞-inch cotton.

The results of an experiment in which 800 lb. of fertilizer were used, showed that when applied ten days before planting and bedded on, the fertilizer produced a gain of 425 lb. of seed cotton; when applied at planting in contact with the seed, the gain was only 179 lb. In a rotation experiment on land that had been under cotton for ten years, a crop of oats followed by soy beans in 1930-31 increased the yield of seed cotton in 1932 by 160 lb. when compared with continuous cotton.

377. *Cotton Marketing.* (*Ann. Rpt. of Exp. Sta. Georgia*, 1932.) Describes a co-operative project with the Division of Cotton Marketing of the U.S. Dept. of Agriculture, the purpose of which is to determine the grade, staple length, and tenderability of cotton produced in the State, and to study the economic problems relating to or affecting the quality of cotton produced.

378. *Georgia's Cotton Holiday.* (*Int. Cott. Bull.*, xi., **43**, 1933, p. 362.) According to Press advices from Atlanta, a Bill has been introduced in the Georgia Assembly with the approval of the House and Senate, which provides for a cotton holiday, making it illegal to plant cotton in that State between January 1, 1934, and December, 1934, in order to eradicate and control boll weevil, pink bollworm, black-rot, and other insect and plant diseases. The Bill would prohibit the planting of any cotton seed, cultivation of any cotton plants, or the gathering of any cotton lint or seed in the State.

379. MISSISSIPPI. *Agronomic Work in* 1932. By C. F. Briscoe *et al.* (*Miss. Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **3**, 1933, p. 319.) Field crop experiments reported on included the following in connection with cotton: Breeding experiments, inheritance studies, varietal trials, cultural tests, fertilizer trials, and experiments on cotton following winter legumes.

380. NORTH CAROLINA. *Field Crops Investigations*, 1930-31. By C. B. Williams *et al.* (*N. Car. Sta. Rpt.*, 1931. Abstr. from *Exp. Sta. Rec.*, 68, **4**, 1933, p. 468.) The work on cotton included: Varietal trials for yield and wilt resistance; breeding experiments; inheritance studies; cultural (including planting) tests with cotton and peanuts; cotton fibre studies concerned with source and care of seed, drag, cell wall diameter, and the effects of locality and of fertilizers.

381. SOUTH CAROLINA: *Cotton Cultivation.* By A. B. Bryan. (*Cotton* [U.S.], **96**, No. 12, 1932, p. 37. Abstr. from *Summ. Curr. Lit.*, xiii., **4**, 1933, p. 74.) A report of the improvements that have been made in the South Carolina crop since the inauguration in 1926 of a contest "for better yield and staple value." About 80 per cent. of the cotton used by mills in the State is $\frac{1}{16}$ inch or longer. By 1925 the crop was so poor that most of the cotton required was obtained from outside; in 1931, the State supplied 61 per cent. of the staple needed. According to the records from more than 2,000 farmers, the return in dollars per acre for different staples averaged as follows: $\frac{7}{8}$ inch 4·18, $1\frac{1}{16}$ inch 8·70, $1\frac{1}{32}$ inch 14·44, $1\frac{1}{16}$ inch 11·07, and $1\frac{1}{8}$ inch 11·76.

382. TEXAS. *Weather and Cotton Yield.* By L. H. Daingerfield. (*Bull. Amer. Met. Soc.*, xiii., **4**, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **1**, 1933, p. 19.) It is stated that the tropical origin of cotton is shown in its tolerance of heat and marked intolerance of cold. Cotton seed should not be planted until the soil reaches a mean temperature of 62° F., which, in a normal season, may not be reached until a month or six weeks after the last killing frost of spring. Sustained high temperatures both night and day throughout the season, with a summer mean of not less than 77°, are most favourable for the growth of the cotton plant. "Other things being equal, the ideal year for cotton would be one in which there was good soil moisture storage during the preceding winter, which should be sufficiently cold to destroy the hibernating pests; followed by an early spring of moderate rainfall, promoting planting and cultivation of crop; a moderately dry, hot summer, with abundant sunshine, but not really droughty and not subject to sharp reversals in rainfall or temperature, thus favouring care and growth of crop and holding down weevil (this condition would favour certain other insects, however, of less serious nature); finally, a fairly dry, bright autumn and late frost, to remove all of the cotton from the fields without deterioration or loss."

COTTON IN FOREIGN COUNTRIES.

383. BELGIAN CONGO. *Cotton Cultivation*, 1932. (*Int. Cott. Bull.*, xi., **43**, 1933, p. 327.) The Compagnie Cotonnière Congolaise and its two subsidiaries, the Société Cotonnière du Nepoko and the Société Cotonnière du Bomokandi, were

responsible for an output of cotton during 1932 of 6,500 tons, which is less than 45 per cent. of that of 1931 (14,600 tons). Various factors contributed to this reduction—viz., temporary suspension of cultivation in certain districts far removed from the river ports, lack of official propaganda, damage caused by insects, and late sowings in the Southern districts. The 1933 output will benefit from the reopening, at the request of the Government, of the Uele and Maniema zones, and from the development of cultivation in the Ubangi and certain other districts. For the 1933 crop the Government of the colony will again provide temporary aid in the form of an advance of necessary funds.

384. Étude Technologique de Cotons du Congo Belge. By Heim de Balsac and Roehrich. (*Coton et Cult. Cotonn.*, vii., **2**, 1932, p. 99.) Diagrams and figures are given for hair length, fineness and strength for the following strains of cotton grown by the Cie Cotonnière Congolaise—Doba, Sibut, and Gondere—and also for other strains grown in the Belgian Congo.

385. Brazil. *Cotton Cultivation.* (*Indus. Text.*, i., **11**, 1932, p. 9. Abstr. from *Summ. of Curr. Lit.*, xiii., **5**, 1933, p. 98.) The cultivation of cotton in Brazil has increased gradually since 1918. Various perennial species are grown, especially in the north and north-east; the annual varieties cultivated are chiefly of the *G. hirsutum* species. Yields per acre are higher than in the United States, and in the irrigated regions are higher than in the irrigated regions of the Nile Valley. The Ministry of Agriculture has established experiment stations and seed farms, and also a section for the examination and classification of cotton for export. The raw cotton export figures show satisfactory progress, and considerable quantities of raw cotton are also absorbed by the important textile industry of Brazil. Tables are given showing the classification of cottons examined in 1931 according to grade and length, and data for the length, strength, convolutions, and hair widths of the different varieties grown.

386. Chinese Cotton Crop. (*Text. Rec.*, L. 600, 1933, p. 45.) Based on reports from eleven provinces, the China Cotton Statistics Association has published a second estimate of this year's Chinese cotton crop. The total area under cotton in these provinces aggregates 37,079,835 mow, while the crop is estimated at 8,094,863 piculs (2,158,630 bales of 500 lb. each).

387. French Cotton Exports: Statistics 1932. By E. Charles-Pierre. (*Fils et Tissus*, March 21, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **9**, 1933, p. 242.) Cotton exports from France in 1932 were less than those of 1931. Particulars are given, country by country.

388. Association Cotonnière Coloniale. *Bull. No.* 10 contains the following articles: "Les fluctuations des matieres premières textiles au cours de l'année 1932," by A. Renouard, dealing with the fluctuations of the cotton market during the year, and their causes; "La culture du coton en Syrie en 1932," by E. Achard; "La culture du coton en Grèce," by B. G. Christidis, in which cultivation methods, pests and diseases, future possibilities for cotton in Greece, and the Greek Cotton Institute, are discussed. The usual notes on cotton in the French Colonies, cotton legislation, etc., are included.

389. Italy. *Textile Companies.* (*Text. Rec.*, L. 601, 1933, p. 23.) Strenuous efforts have been made in Italy to adjust business activities to the straitened situation consequent on the world-wide trade depression, and the effect is seen in a diminution of capital in Italian textile companies. During the year 82 new companies were formed, 89 textile companies increased their capital, 68 other companies lost money by liquidation, while 112 companies reduced their capital.

390. Cotton Growing in the Italian Colonies in Tropical Africa. By J. Legros. (*Int. Rev. Agr.*, Rome, xxiv., 2, 1933, T.60.) Brief accounts of cotton growing in Cyrenaica, Eritrea, and Italian Somaliland, describing the present cultural practice and the changes suggested.

391. Comparaisons Entomologiques pour la Culture du Cotonnier entre la Colonie de l'Erythrée et la Somalie Italienne. By A. Chiaromonte. (*Coton et Cult. Cotonn.*, vii., 2, 1932, p. 83.) An entomological comparison of the colony of Eritrea with Italian Somaliland. A brief account is given of the development of the cotton plant from the seed to the boll, and the pests which may attack it at the different stages of growth are described.

392. Japan. *Wages of Industrial Workers.* (*Text. Rec.*, L. 601, 1933, p. 3.) In a report from the International Labour Office at Geneva the wages of Japanese workers are shown. The average wages of all industrial workers, of whom there are nearly five million in Japan, is given as 3s. a day. A wages table of the textile industries shows that the average rate per day in cotton spinning for adults is 1s. 10d., cotton weaving 1s. 8d., and wool weaving 2s. 7d.

393. *Textile Wages.* (*Int. Cott. Bull.*, xi., 43, 1933, p. 403.) According to recent information from unofficial sources, three Japanese textile concerns were arranging to increase wage rates from 3 to 10 sen per day. The Dai Nihon cotton mills were to increase rates from 3 to 5 sen, and in some cases to 10 sen, 2,500 operatives being affected. The Tokyo Cotton Company was also raising wages on a similar scale in respect of 1,500 operatives. Finally, the Showa Wool mills were to raise the wages of skilled workpeople by 5 to 10 sen per day, and of unskilled workpeople by 3 to 5 sen per day, the total number affected being 650.

394. Manchuria. *Cotton Growing.* (*Man. Guar. Coml.*, 1/4/33.) The Manchukuo Government is reported to have set aside 2,500 acres of rich land in Manchuria Province, formerly owned by the Government of Marshal Chang Haiao-liang, to be distributed in small plots to farmers willing to grow cotton. A survey has revealed that Manchuria consumes 30,000,000 catties (a catty is 13 lb.) of raw cotton annually, whereas the maximum production in any year has been 20,000,000 catties.

395. Peru. *Cotton Cultivation*, 1932. (*Cotton, M/c.* 13/5/33.) In a report on trade conditions in Peru during 1932, H.M. Vice-Consul at Lima writes: "The crop of 1932 did not reach the million quintal mark, which shows a reduction of about 15 per cent. compared with the previous season. This was due, in the first place, to a shortage of irrigation water at the critical stage, and also to the fact that when the water did arrive, the rivers overflowed in many places, causing considerable damage to plantations. Secondly, the bad financial results of the previous season left producers with insufficient capital for adequate preparation of the ground, etc., as partly evidenced by decreased sales of guano. Furthermore, the Ica district and surrounding valleys suffered from a plague of 'wilt,' which in some cases destroyed as much as 40 per cent. of the crop in the area affected. The inadequate preparation of the ground, and the reluctance of banks to make advances against growing crops, with consequent lack of proper cultivation, had not unnaturally a bad effect on the quality. There has been a much smaller percentage of 'high grades' and almost a scarcity of 'white.'"

396. Portuguese East Africa. *Cotton Cultivation.* (*Econ. Condns. in Port. East Afr.*, 1932, by H. A. Ford.) The low prices ruling for cotton in recent years, the ravages of insect pests (chiefly bollworm and stainer) and the irregular rainfall, have resulted in less acreage being planted to cotton. The bollworm damage is stated to amount to as much as 30 to 40 per cent. of the crop. Nevertheless,

conditions are excellent for cotton growing over a large portion of the Colony. The greatest area at present under cultivation is in the district of Lourenço Marques, where the industry is carried on almost entirely by Europeans. In the northern districts both Europeans and natives are engaged in it, especially in Mozambique, Biassa, Cabo Delgado, and Quelimane.

In view of the difficulties confronting the cotton growing industry of recent years, and the fact that growers were receiving prices which were below the cost of production, the Government of Portugal has taken steps to alleviate the position, and by a decree published in April, 1932, it undertakes to pay a premium equal to the difference between 8 escudos per kilo and the average Lisbon quotation for cotton during the month of exportation, on cotton grown in Mozambique and exported to Portugal in national ships for consumption there. Further, all cotton yarns and textiles of foreign origin are now subject to an additional duty of 15 per cent. *ad valorem*, the receipts from which will be devoted to aiding the development of the cotton industry. The decree also provides for the admittance free of import duty of machinery, fertilizers, and packing materials destined for the cultivation and treatment of cotton. This decree will remain in force until June 30, 1934.

397. Russian Textile Machinery. (*Text. Rec.*, L. 600, 1933, p. 45.) According to the *Russian Economic News* the present state of the machinery and equipment of the Soviet textile mills is extremely bad, and the Soviet authorities have ordered extensive repairs to be carried out immediately. In the cotton branch alone, capital repairs are to cost 17,500,000 roubles.

SOILS AND MANURES.

398. Imperial Bureau of Soil Science. (*Rpt. for the Year ending March* 31, 1933.) The work of the Bureau continues to increase. A survey of the soil resources of the British Empire is being organized. Some 3,000 original articles and papers have been abstracted during the year, and about 10,000 cards have been added to the Index. The Bureau makes a special request for reprints to be sent to it for the purpose of lending out to correspondents.

399. An Introduction to Tropical Soils. By Dr. P. Vageler. Translated by Dr. H. Greene. (Macmillan and Co., Ltd., London, 1933. Price 15s.) This book should prove of value to anyone who seriously proposes to set up an agricultural establishment in the tropics. Many such enterprises have failed, or remain barely able to struggle on, from a lack of knowledge of some of the elementary principles upon which all agricultural success depends, such as finance, transport, soil, climate, drainage, etc.

In Chapter I. it is shown that experience with soils in temperate climates is a dangerous guide to the values of tropical soils, where, for example, the author points out that the famous Java soils would in the north be regarded as uncultivable. The high acidity of many tropical soils, the greater rapidity of their chemical reactions, are also very noticeable. Economic facts, too, have important bearings—*e.g.*, the greater cost of transport for fertilizers, etc. "The 'inexhaustible richness of tropical soils' is but seldom found in Nature, and demands of the seeker painstaking attention to the teachings of practical and scientific experience."

Chapter II. deals with the rocks and minerals that form the actual material of the soils. Geology is becoming regarded as a much less certain indicator than formerly of soil quality; the modern science of regional pedology is showing that climate is a more important factor. And here one must realize that the rapidity

of weathering is perhaps ten times as great in the tropics, so that it is of great importance to a soil to have ample mineral reserves. The rocks and minerals are dealt with in detail, and their composition and make-up into rock explained.

In Chapter III. the forms of vegetation that occur in warm climates are considered as sources of organic substance in the soil. There is a popular impression that tropical soils are poor, and especially lacking in humus. This is too generalized an impression: it is pointed out that the decomposition is very rapid, but there is more humus than might be supposed, the humic substances being lighter in colour. The various types of rain forest, monsoon forest, savannah, and steppe are considered, with their lesser and lesser content of humus.

In Chapters IV. and V. the combined effects of all these factors are considered. The amplitude in temperature range has a great effect upon water movement. There is great run-off. Soil types are a good deal modified from purely climatic ones by vegetation, by distribution of rainfall, by local topography and nature of rock. Weathering, humus formation, movement of soil by wind and water, etc., are all considered.

In Chapter VI. the author goes on to the important subject of soil selection, beginning with the statement that 75 per cent. of agricultural failures in the tropics are due mainly or entirely to wrong choice of land, and dealing incidentally with conditions of transport, finance, and other matters which are vital to success and progress. The necessity of a thorough study of the soil types before taking up land is made clear: much work is involved, but the reward is certain, and lack of investigation may mean failure.

400. Soil Physics in Relation to Meteorology. By B. A. Keen. (*Quart. J. Roy. Met. Soc.*, London, 58, 245, 1932. Abstr. from *Exp. Sta. Rec.*, 68, 3, 1933, p. 296.) This article discusses briefly soil classification as related to types found in different climatic zones, but deals particularly with the relation of meteorology to soil temperature and moisture, the soil atmosphere, and cultivation of the soil. Results of investigations at Rothamsted on the movement and distribution of water in the soil are freely drawn upon.

The general conclusion reached is that "the properties of the soil are very closely related to its moisture, temperature, and air supply, and thus provide direct contacts with certain branches of meteorology. The amount and distribution of moisture in the soil are the resultants of rainfall, evaporation, and percolation; the march of soil temperature is directly controlled by insulation and radiation; changes in the atmosphere affect the composition of the atmosphere in the pores of the soil. Nor is this all; moisture, temperature, and atmosphere are not independent variables; for example, changes in moisture content have important and unexpected effects on soil temperature." More specifically, it is shown that downward percolation of water appreciably reduces the loss of heat from the soil, but that movement of soil moisture is much less both in amount and extent than has previously been supposed. Evidence is offered to show that water which has reached a depth of 6 feet in the average soil is not drawn back to the surface again by evaporation, and that many cultivation operations which have been supposed to conserve subsoil water for the use of plants are not effective for this purpose.

401. An Introduction to the Scientific Study of the Soil. By N. M. Comber. (Edward Arnold and Co., London, 1932. Price 7s. 6d. Abstr. from *Bull. Imp. Inst.*, xxx., 4, 1932, p. 527.) The present edition has amplified and brought up to date the information included in the previous edition published in 1927, especially in the important sections dealing with the mechanical analysis of soils, soil microbiology, and the classification of soils. In this last section

the various systems of classification and their limitations are indicated, and attention is drawn to the importance of recent work by Russian investigators. An excellent feature, unusual in a book of this character, is a chapter devoted to the literature of soil science, indications and guidance being given as to the use by the student of original papers and abstracts, a matter which the author rightly regards as of the first importance. Although the amount of space devoted to each item of the subject is necessarily short, the work gives a comprehensive survey of the whole field, dealing with both practical and academic aspects. It should prove useful, not only to students, but to others desirous of obtaining a general idea of the present position of the science of the soil.

[*Cf.* Abstr. **57**, Vol. VI. of this REVIEW.]

402. CONTRIBUTION TO OUR KNOWLEDGE OF THE CHEMICAL NATURE AND ORIGIN OF HUMUS. I. ON THE SYNTHESIS OF THE "HUMUS NUCLEUS." II. THE INFLUENCE OF "SYNTHESIZED" HUMUS COMPOUNDS AND OF "NATURAL HUMUS" UPON SOIL MICROBIOLOGICAL PROCESSES. By S. A. Waksman and K. R. N. Iyer. (*Soil Sci.*, **34**, 1, 1932. Abstr. in *Exp. Sta. Rec.*, 68, 2, 1933, p. 163.)

403. STUDIES ON THE CARBON AND NITROGEN CYCLES IN THE SOIL. I.-III. (*J. Agr. Sci. England*, xx., 3, 1930. Abstr. from *Exp. Sta. Rec.*, 68, 2, 1933, p. 163.) The work described in this group of papers contributed from the Rothamsted Experimental Station "is concerned chiefly with the humic matter and with the carbon and nitrogen economy of the soil." The first paper (by H. J. Page) consists principally of a collation and interpretation of the results of previous work reported by a number of investigators. The second paper (by C. W. B. Arnold and H. J. Page) deals with the extraction of the organic matter of the soil with alkali. In the third paper (by M. M. S. du Toit and H. J. Page) the formation of natural humic matter is studied.

404. A COMPARISON OF METHODS FOR DETERMINING THE HYDROGEN-ION CONCENTRATION OF SOILS. By R. J. Best. (*J. Agr. Sci., England*, xxi., 2, 1931. Abstr. from *Exp. Sta. Rec.*, 68, 3, 1933, p. 293.) The author used a simple form of the antimony oxide electrode for soil pH measurements, comparing the results with those obtained by the use of the quinhydrone and hydrogen electrodes, and giving special attention also to the limitations of the quinhydrone electrode as applied to the examination of alkaline and manganiferous soils. The nature and the control of potential drifts were also investigated.

"The adaptation lag of the quinhydrone electrode has been found to reach more serious proportions in soils than in solutions of pure mineral acids, and the antimony oxide electrode was found to be subject to the same lag. It has been definitely shown that manganese in an oxidized state is responsible for the non-applicability of the quinhydrone electrode to some Australian basaltic soils."

405. THE DISPERSION OF SOILS IN MECHANICAL ANALYSIS. By G. W. Robinson (*Tech. Commn., No.* 26, Imp. Bur. of Soil Sci., Rothamsted, 1933.) The author presents the following conclusions: (1) As a result of the examination of 120 representative samples of soil, mainly overseas, but including a few British soils, it appears that the International method with suitable modifications gives satisfactory dispersion in mechanical analysis. (2) The principal modification consists in the substitution of sodium hydroxide for ammonia as a dispersing agent. (3) The dispersion thus attained is so efficient that the amount of shaking required may be appreciably reduced. (4) The difficulty with gypseous soils may be obviated by: (*a*) removing coarse gypsum after peroxiding and before acid treatment; (*b*) using a stronger acid; and (*c*) washing with 10 per cent. ammonium acetate. (5) Oxidation of organic matter by hydrogen peroxide appears to be necessary with all soils containing more than about 1 per cent. of organic carbon

(6) By including a preliminary boiling with water, it is possible to secure oxidation with more dilute (2 per cent.) peroxide. (7) Manganese dioxide, which interferes with peroxide attack, may be decomposed by preliminary digestion with water and $NaHSO_3$. (8) Aluminous soils present a special difficulty as they are not dispersible in alkaline solution. Dispersion may be effected in a slightly acid medium. (9) For most soils the proposed modification gives results which agree fairly clearly with those by the International (ammonia) method.

406. Statistical Study of Available Potassium in certain African Soils. By J. F. de Ferriere. (*Ann. Agron.*, **2**, 1932, p. 683. Abstr. from *List No.* 16, *Pubns. on Soils and Fertilizers*, Imp. Bur. of Soil Sci., Rothamsted, 1932, p. 6.) Deals with the relation between the pH of these soils and their potassium content.

407. Soil Fertility Problems in Natal. By C. O. Williams. (*Sci. Bull. No.* 110, Dpt. of Agr. S. Afr. Chemistry Series, No. 124, 1932.) A brief description of the chief soil types in Natal and Zululand, and a general survey of the manurial experiments carried out at the Cedara School of Agriculture.

408. Soil Fertility and the Importance of Deep Ploughing and Cultivation. By E. Petrov. (*Tashkent Sci. Res. Inst. Cotton Cult. Ind. Irr.*, **49**, 1931, p. 12. Abstr. from *List No.* 16 *Pubns. on Soils and Fertilizers*, Imp. Bur. of Soil Sci., Rothamsted, 1932, p. 7.) Investigation of the soil moisture in relation to the root system. Deep ploughing and cultivation increased the yield of cotton and accelerated its ripening.

409. Soils and Fertilizers. By E. M. Crowther. (Reprinted from *Rpts. of the Progress of Applied Chemistry*, xvii., 1932.) Workers in soil science will appreciate this careful review of progress in all its branches. The various sections deal with the Chemistry of Soil Formation; Soil Formation and Colloidal Clay; The Physical and Chemical Properties of Colloidal Clay; Ionic Exchange in Inorganic and Organic Colloids; Units in Base-exchange Work; The Physical Properties of Soils; Erosion; The Determination of Soil Organic Matter; The Nature of Soil Organic Matter; Iron, Aluminium, and Manganese in Soil Fertility; Smoke Damage to Soils, Crops, and Stock; Alkali Soils; Fertilizers; Nutrient Uptake and the Use of Fertilizers; Liming Materials; The Fertilizer and Feeding Stuffs Act, 1926; Fodder Conservation.

410. Soil and Fertilizer Studies in North Carolina. By C. B. Williams. (*N. Car. Sta. Rpt.*, 1931. Abstr. from *Exp. Sta. Rec.*, 68, **4**, 1933, p. 452.) Includes studies of nitrogenous and other fertilizers for cotton.

411. Fertilizer Experiments with Cotton. By E. B. Reynolds *et al.* (*Bull. No.* 469, Texas Agr. Exp. Sta., 1932.) Gives the results of seven years' experiments with fertilizers on cotton at the several substations, Texas. The sandy loams in the eastern part of the State are deficient in nitrogen, phosphoric acid, and potash. The application of 200 to 400 lb. per acre of a 4-6-4 or 4-8-4 fertilizer, or a fertilizer supplying similar ratios and amounts of plant food, is recommended for cotton on these soils. The Lake Charles clay soils are in need of phosphate. The use of 100 lb. of superphosphate, or 200 to 600 lb. of a 4-8-0 fertilizer per acre, or a fertilizer with equivalent amounts and proportions of plant food, is suggested for cotton on these soils. The Lufkin fine sandy loam apparently needs phosphoric acid and potash before it does nitrogen. The 4-12-4 and 0-12-4 fertilizers gave better results on this soil than the other fertilizers used. Although fertilizers gave some response on the Goliad fine sandy clay loam at Beeville, on the Houston clay and Houston black clay at Temple, and on the San Saba clay at Denton, in general the use of fertilizers was not profitable on these soils.

412. Ammoniate and Nitrate Nitrogen for Cotton in Water Culture. (*Ann. Rpt. of the Exp. Sta. Ga.*, 1932.) In this experiment, conducted at the Georgia Experiment Station in 1932, plants were carried to about the first open boll stage. With the use of greater volumes of renewal solutions and more attention to reaction control, the ammonia cultures produced more dry matter than the nitrate cultures—a result contrary to those generally reported for reaction levels well below pH 7·0. Continuance of the investigation served to emphasize the importance and difficulty of reaction control where ammonium salts were used as sources of nitrogen. Analyses of saps of the plants grown on the two forms of nitrogen showed that the tendency of ammonia nitrogen to quicken soluble organic nitrogen formation, especially in the early growth stages, applies to mobile carbohydrates also. Preliminary examination of results of leaf temperature measurements indicated no difference in the transpiration rates of ammonia and nitrate plants great enough to account for the greater calcium uptake of the nitrate plants.

413. Effect of Nitrogenous Fertilizers on Cotton under Conditions of a Vegetative Experiment. By D. A. Sabinin *et al.* (*Tashkent Sci. Res. Inst. Cotton Cult. Ind.*, **37**, 1931, pp. 3-36. Abstr. from *List No.* 16, *Pubns. on Soils and Fertilizers*, Imp. Bur. of Soil Sci., Rothamsted, 1932, p. 18.) Heavy doses of nitrogenous fertilizers delayed the ripening of cotton plants by twenty days; this was avoided by the simultaneous application of double superphosphate. The ratio P:N is taken as the factor determining the cotton growth.

414. On the Fixation of Atmospheric Nitrogen by the Leguminosæ Bacteria. (*Comp. Rend. des Séances de l'Acad. des Sci.*, Paris, **6**, 1933. Abstr. from *Int. Rev. Agr.*, Rome, xxiv., **3**, 1933, T. 129.) It is commonly thought that readily assimilable nitrogenous compounds have an unfavourable influence on nitrogen fixation by the nodule bacteria of the Leguminosæ, by reducing the faculty of the plants for utilizing atmospheric nitrogen. It has, however, frequently been observed that moderate dressings of nitrogenous fertilizers have a beneficial effect on the yield of legumes.

It has now been proved by a series of scientifically controlled experiments carried out by H. Burgevin that the symbiotic fixation of nitrogen is not appreciably influenced by application of nitrogenous fertilizers, even with relatively heavy dressings, and that small quantities of nitrogen encourage the growth of legumes in the early stages and do not interfere with the fixation of atmospheric nitrogen by the plant later.

415. Nitrate-Assimilating Soil Bacteria. By F. B. Smith and P. E. Brown. (*J. Amer. Soc. Agron.*, **24**, 1932, p. 749. Abstr. from *List No.* 16, *Pubns. on Soils and Fertilizers*, Imp. Bur. of Soil Sci., Rothamsted, 1932, p. 11.) Tests in pure culture with species of Azotobacter, Raidobacter, Aerobacillus, Pseudomonas and Achromobacter isolated from soils in which nitrate assimilation occurred showed that they were able to assimilate nitrates.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

416. A Note-Book of Tropical Agriculture. Compiled by R. Cecil Wood. (Pubd. by the Imperial College of Tropical Agriculture, Trinidad, 1933. Price 5s. post free.) This is an extremely useful little book, of convenient size for the pocket, which should prove invaluable to those interested in tropical agriculture. Facts and figures, compiled from many sources, are given concerning the following: Weights and Measures; Mensuration and Surveying; Buildings and Roads; Machinery; Labour; Soils; Manures; Crops; Foods and Feeding; Live

Stock; Dairying; Recipes for Insecticides, Fungicides, etc.; Statistics; Current Prices, 1931; Institutions of Service to Agriculturists in the Tropics; Colonies, Protectorates, and Mandated Areas of the British Empire (giving area, population, and chief exports). Altogether a most informative little book.

417. COTTON. By G. Kranzlin and A. Marcus. (Pubd. by Walter Bangert, Berlin-Charlottenburg. Abstr. from *J. of Text. Inst.*, xxiv., 4, 1933, p. 69.) In this small handbook a general account is given of the plant and the morphology of its vegetative and reproductive organs, followed by a brief discussion of the species and varieties. Much of the book is concerned with general questions of cultivation, but chapters are also included on breeding and seed production, the choice of varieties (with an indication of the growth conditions suited to each type), and on pests and diseases.

418. AGRICULTURAL METEOROLOGY. By L. A. Ramadas. (Reprinted from *Curr. Sci.*, i., 7, 1933, p. 191.) The author points out the value of the work of the Agricultural Meteorologist both to the farmer and to the State, and briefly describes the work to be undertaken by the new branch on Agricultural Meteorology opened in August last at the Meteorological Office, Poona.

419. THE MEASUREMENT OF RAINFALL IN AGRICULTURAL CLIMATOLOGY. By L. Chaptal. (*Ann. Agron.*, 1, 1931, p. 223. Abstr. from *List No.* 16, *Pubns. on Soils and Fertilizers*, Imp. Bur. of Soil Sci., Rothamsted, 1932, p. 6.) Mathematical determinations of the optimum intensity and most effective amounts of precipitation as related to soil conditions and plant growth.

420. EFFECT OF IRRIGATION ON THE DEVELOPMENT OF COTTON. By A. F. Makarov and N. A. Gelfand. (*Tashkent Ak-Kavak Expt. Irr. Sta.*, 12, 1931, p. 3. Abstr. from *List No.* 16, *Pubns. on Soils and Fertilizers*, Imp. Bur. of Soil Sci., Rothamsted, 1932, p. 18.) Experiments on a large scale show the necessity of watering before the flowering period and at the beginning of it; watering at the end of it was never effective.

421. NEW METHODS OF COTTON CULTURE. By K. A. Visozky. (*Tashkent Sci. Res. Inst. Cotton Cult.*, 1932, pp. 3-16. Abstr. from *List No.* 16, *Pubns. on Soils and Fertilizers*, Imp. Bur. of Soil Sci., Rothamsted, 1932, p. 18.) Methods of hybridization, vegetative multiplication and winter storage of cotton plants are described.

422. COTTON: GINNING AND BALING. By R. A. Butler. (*Cotton* [U.S.], 97, 1, 1933, p. 30. Abstr. from *Summ. of Curr. Lit.*, xiii., 6, 1933, p. 126.) Careful selection of seed is necessary in order to avoid deterioration in the length and character of cotton. Depreciated character necessitates the purchase of cotton longer in average staple length than would otherwise be necessary to produce a yarn of required strength, and results in larger percentages of waste and higher costs of processing. The same may be said of cotton which has been damaged in ginning. Investigations of the ginning process are at present being carried out, and there is evidence that pre-cleaning and drying, combined with a moderate gin speed, gives the best results. Improvements in the method of packing cotton are desirable, as the average bale presents an unsightly appearance, and has an excessive amount of tare which increases shipping cost, does not protect all parts of the bale from damage, and distributes jute fibres on the outside layers.

423. NEW COTTON PICKER IN THE U.S.S.R. (*Int. Cott. Bull.*, xi., 43, 1933, p. 399.) A new six-row cotton picker has been constructed at the Petrovsky plant in Kherson, according to the model worked out by a group of scientists and engineers of the Ukrainian Scientific Research Institute for Mechanization of Agriculture. This picker has a much higher production capacity than the

American two-row cotton picker, and makes full use of the tractor power possible. It gives an additional operation, that of sorting cotton according to grades. This picker and a special cleaning machine for the elimination of leaves complete the series of Soviet cotton machines for the mechanization of cotton cultivation and of the cotton industry.

DISEASES, PESTS, AND INJURIES, AND THEIR CONTROL.

424. Reliability of Differences between Data obtained in Cotton Insect Investigations. By J. C. Gaines. (*J. of Econ. Ent.*, xxvi., **1**, 1933, p. 274.) *Summary.*—The mean difference between the point and the survey methods used to take the boll weevil infestation is not significant. The mean difference between the sweeping and examination methods used to take the cotton flea hopper population is significant. Judging from these data, the number of insects taken in 100 sweeps is not as good a sample of the population in the buds of 100 plants as the number of insects recorded by the examination method. The mean difference between the average plant height records taken on 100 plants at each of three points, and the average plant height records taken on 100 plants at one point in experimental plats, is not significant.

425. Barbados. *Cotton Pests.* (*West Ind. Comm. Circ.*, xlviii., **899**, 1933, p. 115.) The pink bollworm has made an early appearance in numbers sufficient to cause economic damage, and it is evident that without the strictest control it would be impossible in a few years to grow Sea Island cotton.

426. Le "Ver Rose" du Coton (*Gelechia gossypiella*, Saund.) dans les Districts des Deux Uele. By J. M. Vrydagh. (*Bull. Agric. Congo Belge*, xxiii., **1**, 1932. Abtrs. from *Rev. App. Ent.*, xxi., Ser. A., **4**, 1933, p. 155.) The local distribution of *Platyedra* (*Gelechia*) *gossypiella*, Saund., on cotton in the Welle region of the northern Belgian Congo is discussed, and general information on its biology is given, together with descriptions of the larvæ, pupæ and adults, and an outline of measures for control.

427. The Response of Corn Earworm Moths to Various Sugar Solutions. By L. P. Ditman and E. N. Cory. (*J. of Econ. Ent.*, xxvi., **1**, 1933, p. 109.) Corn earworm moths (*Heliothis obsoleta*) responded in varying degrees to ten sugars in solutions. On the basis of molar concentrations, sucrose, invert sugar, and fructose proved most attractive in the order named.

428. The Melon Aphid, *Aphis gossypii*, Glover. By C. C. Goff and A. N. Tissot. (*Flor. Sta. Bull.*, **252**, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **4**, 1933, p. 501.) Studies of the life-history and bionomics, natural enemies, and artificial control, are presented.

429. Specie Nuove di *Empoasca* (Hemiptera-Homoptera) e Appunti di Corologia. By G. Paoli. (*Mem. Soc. ent. ital.*, ix., 1932, p. 109. Abstr. from *Rev. App. Ent.*, xxi., Ser. A., **2**, 1933, p. 60.) The new species described are *Empoasca distinguenda* on cotton in the Belgian Congo, and on cotton, maize and beans (*Phaseolus*) in the Transvaal; *E. benedettoi* on cotton in Italian Somaliland, the Anglo-Egyptian Sudan and Tanganyika; *E. formosana* on an unnamed plant in Formosa; and *E. decedens* on beans and beet in Italy.

A list shows the distribution and food-plants of a number of Jassids, and includes records of infestation of cotton by *E. dolichi*, Paoli, in the Transvaal and Belgian Congo; *E. facialis*, Jac., in Italian Somaliland, Tanganyika, Nigeria, the Belgian Congo and the Transvaal; *E. decipiens*, Paoli, in Egypt; and *Erythroneura lubicæ*, China, in the Anglo-Egyptian Sudan and Italian Somaliland. Naudé

records *E. facialis* as abundant on peas, cowpeas and groundnuts in South Africa; but in the author's collection *E. dolichi* was abundant from these plants, and *E. facialis* was rare and taken only from groundnuts.

430. ANTI-LOCUST INVESTIGATION. *Second International Conference, Paris,* 1932. (*Int. Rev. Agr.*, Rome, xxiv., **1**, 1933, M. 5.) Resolutions were passed calling for international action for the study of locusts, location of breeding grounds by entomologists specially appointed for the work, and the organization of control measures.

431. THE LOCUST CAMPAIGN. By R. W. Jack. (*Rhod. Agr. Jour.*, xxx., **3**, 1933, p. 194.) Deals with the invasion of various districts of Southern Rhodesia by the Migratory Locust (*Locusta migratorioides*) and the Red Locust (*Nomadacris septemfasciata*) and the methods employed for their destruction, which include spraying by arsenite of soda solution, dusting with arsenite of soda powder, poison bait, contact insecticides, and flame throwers.

432. SODIUM FLUOSILICATE AS A POISON AGAINST THE HOPPERS OF *Locusta migratoria migratorioides*, R. and F., IN NIGERIA. By F. D. Golding. (*Bull. Ent. Res.*, xxiii., **4**, 1932, p. 449. Abstr. from *Rev. App. Ent.*, xxi., Ser. A., **3**, 1933, p. 125.) Owing to the potential danger from the use of arsenicals against *Locusta migratoria* in Northern Nigeria, to the native tribes who use locusts as food, as well as to domestic animals, tests have been made with sodium fluosilicate.

The following is taken from the author's summary: This poison was found as effective in baits as sodium arsenite when used in the same concentration—viz., 2·44 per cent.—but was slower in action. When guinea-corn (*Sorghum*) bran was used as the carrier, it was necessary to add salt as an attractant, although this was not the case when sawdust, chopped hay or chaff were employed.

From an examination of the results of experimental work on the relative toxicities of sodium fluosilicate and arsenical compounds to domestic animals in various parts of the world, it is concluded that the former is less toxic to stock, but that the increased degree of safety acquired through its use is not so great as is popularly supposed. A definite advantage of baits containing fluosilicate is that they are repellent to many animals, whereas those containing sodium arsenite are attractive to stock. Although sodium fluosilicate is cheaper than sodium arsenite, the need for adding salt to baits containing it would largely vitiate this advantage in Nigeria where the cost of transport to the interior is very high. Experiments showed that chopped hay was a satisfactory carrier with either fluosilicate or arsenite; and a test of paper (newspaper torn up to pieces of about 2 square inches) as a carrier gave promising results.

433. THE EFFECT OF SOLAR RADIATION AND WIND ON THE TEMPERATURE OF THE BODY AND THE BEHAVIOUR OF THE LARVÆ OF THE LOCUST *Locusta migratoria*, L. By I. Strel'nikov. (In Russian.) (*Sborn. VIZRa*, **4**, 1932, p. 76. Abstr. from *Rev. App. Ent.*, xxi., Ser. A., **4**, 1933, p. 160.) Exact experimental data on the subjects indicated in the title are given. Under the influence of direct insolation the body temperature of hoppers may become as high as 42·7° C. (107·96° F.) when the air temperature is only 28° C. (82·4° F.). It is subject to great fluctuations caused by wind, by the angle at which the sun's rays strike the insect, and by its colour. Thus hoppers of the swarming phase had a temperature up to 5·8° C. (10·44° F.) higher than those of the solitary phase under the same conditions of insolation. The air-sacs are of great importance in the regulation of body temperature, which rises sharply during flight, but is lowered through the ventilation of the air-sacs. The importance of studying micro-climatic factors with reference to the behaviour of locusts is stressed.

434. An Unreported Fungous Disease of the Philippine Migratory Locust. By G. M. Reyes. (*Philipp. Jour. of Sci.*, xlix., **3**, 1932, p. 407. Abstr. from *Rev. App. Mycol.*, xii., **4**, 1933, p. 216.) In September, 1929, migratory locusts at the Alabang locust laboratory were heavily infested by *Beauveria globulifera*, said to be reported for the first time from the Philippines. Diseased insects suffer from loss of appetite, weakness, and muscular paralysis ending in death. On dissection the affected insects were found to contain hyphæ in the air cavities of the thorax and in the thoracic and abdominal tissues, while mycelial tufts emerge from certain parts of the body and extend over the chitinous integument. The most conspicuous external feature of the disease, however, is the presence of a cottony-white, floccose growth, protruding from the junctures of the body segments and the joints of the legs. Later these white mycelial masses sporulate heavily and assume an ivory or creamy tint. The diseased insects become mummified, the fungus covering practically the whole carcase. The fungus was readily isolated on potato glucose agar, and proved to be highly pathogenic to the locusts, especially to young and newly moulted individuals. *B. globulifera* was still viable after 295 days at room temperature (28° to 32° C.) and after 320 in the ice-box (13° to 15° C.); steamed glutinous rice was found to constitute a particularly suitable medium for its growth.

435. The Sulphur Problem. By Z. Rodionov. (In Russian.) (*Sborn. VIZRa.*, **4**, 1932, p. 130. Abstr. from *Rev. App. Ent.*, xxi., Ser. A., 4, 1933, p. 161.) The use of sulphur dust in the Russian Union for the control of the red spider (*Tetranychus* sp.) on cotton and for various plant diseases, is in general not economically justifiable, as about 80 to 90 per cent. of the dust is usually wasted owing to its being carried away by wind, or subsequently covered with earth during the cultivation of the soil between the rows of the plants or in the course of irrigation. The toxic properties of sulphur and the factors responsible for them are briefly discussed, and the results are given of investigations in Moscow of the causes of its action on pests. It was found that under certain conditions sulphur dissolves in water and evaporates with it, reaching the pests as a water solution. In a dusted field this may be explained by the fact that about 10 tons of water may evaporate in 24 hours from 1 acre. Evidence has been secured that dusting infested cotton before irrigating the field does not affect the red spider, whereas treatment three or four days after irrigation results in 81 to 100 per cent. mortality in 10 to 15 days. These facts indicate that sulphur could be successfully used as a spray, which would result in a marked economy of material.

436. Tropical Plant Diseases: Their Importance and Control. By E. J. Butler. (*Trop. Agriculture*, x., **3**, 1933, p. 57.) The serious effect of epidemics of plant diseases on the development both of plantation industries and of indigenous agriculture in the tropics and sub-tropics is discussed. So serious have some of these outbreaks been that not only have they affected a single industry, but also jeopardized the whole future of certain agricultural regions. Fortunately, the labours of plant pathologists, initiated during comparatively recent times, have afforded a certain measure of protection. Dr. Butler stresses the increasing importance of the work of the plant pathologists to the welfare of agriculture both in temperate and tropical zones.

437. The Environmental Coincidence as a Factor in Incidence and Control of Plant Diseases. By T. D. Jarvis. (*Sci. Agr.*, xiii., **1**, 1932, p. 36. Abstr. from *Rev. App. Mycol.*, xii., **2**, 1933, p. 108.) This is a discussion of the evidence supplied by recent phytopathological investigations (a survey of which is given) that variations in the incidence and external expression of physiological

virus and parasitic diseases of plants may be explained, in a large measure, in terms of the basic metabolic disturbances brought about in the plants under the influence of different complexes of environmental conditions, which the author terms environmental coincidence, and which affect the predisposition of the plant either for resistance or susceptibility. In his opinion, a better understanding of the problem of the incidence and control of plant diseases may be attained by a world-wide and international study of the ecological conditions best adapted for growing a given crop, the fundamental principles of which are briefly indicated.

438. ENVIRONMENTAL FACTORS IN RELATION TO PLANT DISEASE AND INJURY: A BIBLIOGRAPHY. By J. D. Wilson. (*Ohio Agr. Exper. Stat. Tech. Ser., Bull.* **9**, 1932. Abstr. from *Rev. App. Mycol.*, xii., **2**, 1933, p. 107.) This extremely useful bibliography of 3,689 titles, arranged alphabetically under authors, comprises some of the papers in botanical literature referring to the injurious influence of environmental factors on plants. The factors considered are separately indexed in the second section of the bulletin, while the diseases, injuries, and abnormalities discussed are indicated for each host in the third, which also includes, under the name of the pathogen, a list of the papers in which the action of the factor on the pathogen only, without reference to the host, is discussed. A host index of scientific and popular names is appended.

439. EFFECTS OF ANAEROBIC CONDITIONS ON THE GROWTH OF THE COTTON ROOT-ROT FUNGUS, *Phymatotrichum omnivorum*. By D. C. Neal and R. E. Wester. (*Phytopath.*, xxii., **11**, 1932, p. 917. Abstr. from *Rev. App. Mycol.* xii., **4**, 1933, p. 216.) The growth of *Phymatotrichum omnivorum*, the causal organism of cotton root rot in Texas, was found in laboratory experiments to be inhibited by anaerobic conditions and considerably restricted by concentrations of carbon dioxide exceeding 25 per cent. It is, however, not killed in an atmosphere of 100 per cent. nitrogen or carbon dioxide, and growth is soon resumed on its return to aerobic conditions. Possibly the aerobic requirements of the fungus may explain the differences in root-rot infection observed in cotton fields following such treatments as subsoiling, fallowing, or fallow combined with deep tillage. Subsoiling infested areas in the late summer or early autumn may provide the necessary aeration for sclerotial germination, thereby reducing the chances of winter survival of the fungus. The recurrence of the disease in areas kept in clean fallow for three or four years may be due to the anaerobic conditions of the subsoil in the highly calcareous, black waxy lands of Texas, as well as to deep-seated infections in tree roots below the plough sole.

440. SOIL CULTURES FOR THE LABORATORY PRODUCTION OF SCLEROTIA IN *Phymatotrichum omnivorum*. By B. F. Dana. (*Phytopath.*, xxi., **5**, 1931. Abstr. from *Exp. Sta. Rec.*, 67, **5**, 1932, p. 545.) A method is described for culturing *P. omnivorum* in which non-sterilized soil is used as a cultural medium and newly diseased roots as inoculum. This type of culture is said to be well adapted to a study of the moisture and temperature requirements for the production of strands and sclerotia in the cotton root-rot fungus under conditions comparable to those found in the field, and to test the effectiveness of chemical and fertilizer applications for cotton root-rot control.

441. COTTON ROOT-ROT DISEASE: OCCURRENCE, DEVELOPMENT AND CONTROL. By C. J. King. (Reprint No. 1284 from *U.S. Dept. Agr. Yearbook of Agr.*, 1932. Abstr. from *Summ. of Curr. Lit.*, xiii., **7**, 1933, p. 159.) The occurrence of cotton root rot is briefly discussed, and a short account is given of the development of the root-rot fungus. Methods of control are reviewed, and it is pointed out that an entirely satisfactory method has not yet been discovered.

442. Egyptian Cotton Wilt Disease: Investigations. By A. Fikry. (*Min. Agr. Egypt, Tech. Sci. Serv. Bull. No.* 119, 1932. Abstr. from *Summ. of Curr. Lit.*, xiii., 8, 1933, p. 194.) A comprehensive account of the mycology and pathology of the wilt disease in Egypt. Previous work is reviewed, the occurrence and symptoms of the disease are noted, and the isolation and identification of causative organisms are described in detail. Three species of *Fusarium* are definitely identified, and the optimum conditions for their active attack on cotton plants are ascertained as follows: Temperature, 27° C.; R.H., 90 to 100 per cent.; pH, 7 for culture media or 7·8 to 8·3 for soils; soil moisture corresponding with 50 to 60 per cent. of the water-holding capacity. Details are given of several culture media used in the investigation.

443. Fusarium Wilt Toxin: Isolation. By M. Lüdtke and H. Achmed. (*Biochem. Z.*, 257, 1933, p. 256. Abstr. from *Summ. of Curr. Lit.*, xiii., 5, 1933, p. 116.) The authors have grown *F. vasinfectum* (from cotton plants) and *F. lycopersici* (from tomatoes) in culture media in the hope of isolating the toxin that causes wilting. They have evidence of the production of substances like amines, and have therefore tried the effect of several bases and amino-acids on seedlings of tomato and summer wheat. The volatile amines had a particularly powerful wilting effect.

444. Verticillium Wilt of Cotton in Mississippi. By L. E. Miles and T. D. Persons. (*Phytopath.*, xxii., 9, 1932, p. 767. Abstr. from *Rev. App. Mycol.*, xii., 2, 1933, p. 92.) A wilt of cotton in Mississippi, the symptoms of which are indistinguishable from those of *Fusarium vasinfectum*, was experimentally shown to be due to *Verticillium albo-atrum*, previously reported by Sherbakoff from Mississippi and Tennessee. The average incidence of infection on diseased plots kept under observation for the past four years was 62·82 per cent. in 1928, 80 in 1929, 35·53 in 1930, and 17·66 in 1931. In these plots, however, *F. vasinfectum* was also present, and may have been responsible for some of the wilting in the early years, though in 1931 it was not detected. None of the eighteen standard varieties of cotton tested showed any appreciable degree of resistance to the disease, which was found in almost all cases on the heavy sedimentary loam soils of the Mississippi Delta; one locality outside the Delta limits is situated on rich, loamy, bottom land. Of 706 wilted cotton plants from thirty-seven counties, 626 yielded cultures of *F. vasinfectum* and the remaining 80 *V. albo-atrum*.

GENERAL BOTANY, BREEDING, ETC.

445. The Physiology of the Cotton Plant. I. Investigation of the Processes of Assimilation. The Dynamics of the Stomatal Apparatus, and the Transpiration of the Cotton Plant. By V. A. Novikov. (*Zhur. Opytn. Agron. Iugo-Vostoka*, viii., 2, 1930. Eng. abs., pp. 303-4. Abstr. from *Exp. Sta. Rec.*, 68, 2, 1933, p. 170.) The assimilation process in the cotton plant reaches its maximum in the time of brightest sunshine, generally ranging low on dark days, though a degree of exception to this is to be found in certain sorts. Early varieties assimilate 50 per cent. more energetically than do the late varieties. Low temperatures may here constitute a factor stimulating to growth. Plants growing in dry soil show much lower assimilation than do plants in soils having normal moisture. Outflow of assimilated material from the leaves differs characteristically with variety, at different hours, and for the day as a whole. In clear sunshine the stomata open, maximally about 12 a.m. to 1 p.m. Toward 3 p.m. the aperture begins to decrease progressively, closing about 8 p.m. The aperture averages less in cloudy weather. The maximum of assimilation coincides

with the maximum of stomatal aperture. Transpiration decreases toward noon in correspondence with the high accumulation of dry matter in the leaf, but the decrease does not correspond to stomatal aperture decrease. Decrease of transpiration in the hours in which the water content remains constant and the stomata remain wide open is thought to be connected in some way with the accumulation of assimilated material in the leaf. The capacity of regulating stomatal aperture is considered to be connected with drought resistance. Cotton plants under ordinary field conditions transpire daily about 28·054 tons per hectare.

446. The Physiological Significance of the Xeromorphic Structure of Plants. By N. A. Maximov. (*J. of Ecology*, xix., **2**, 1931.) Deals with the peculiarities that characterize the xeromorphic structure of plants, and the physiological significance of these characters. Xerophytes are defined by the author as "plants of dry habitats which are able to decrease the transpiration rate to a minimum when under conditions of water deficiency."

[*Cf.* Abstr. **355**, Vol. VI. of this Review.]

447. Anatomy of Normal and Acid-Injured Cotton Roots. By U. R. Gore and J. J. Taubenhaus. (*Bot. Gaz.*, 92, **4**, 1931. Abstr. from *Exp. Sta. Rec.* 67, **5**, 1932, p. 545.) Anatomical studies were made of acid-injured cotton roots. Marked proliferations of acid-injured cotton roots were found to arise from cell division of the ray cells of the xylem and phloëm and from a stimulation of the cambium and phellogen. The original phloem may be killed and become functionless. The proliferated cells were generally thin-walled parenchyma cells varying somewhat in size and form. Tyloses were present in both cases, but did not seem to be related to acid injury.

[*Cf.* Abstr. **604**, Vol. IX. of this Review.]

448. Parent-Progeny Correlation in Cotton. By J. F. O'Kelly and W. W. Hull. (*J. Amer. Soc. Agron.*, **25**, 1933, p. 113. Abstr. from *Plant Breeding Abstracts*, iii., **3**, 1933, p. 131.) The purpose of the present paper is to show how far certain selection characters of the parent plants are reproduced in the progeny. The characters studied are lint yield, lint percentage and staple length, and the varieties used are Trice, Miller and Lone Star. Coefficients of correlation between each of the characters in the parent plant and the three characters in the progeny are reported. It appears that lint percentage and staple length, but not lint yield, can be used to determine, before planting, which plants must be discarded.

449. Memoirs of the Cotton Research Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The fifth number of Series A., Genetics, has recently been issued, and contains the following paper, reprinted from the *Annals of Botany*:

Cytological Studies in Cotton: I. The Mitosis and Meiosis in Diploid and Triploid Asiatic Cotton. By A. Skovsted. 1. A technique developed specially for cotton and adapted to a tropical climate has been described in detail.

2. The genetical constitution of a triploid Asiatic cotton appearing as a sterile rogue in culture was studied. It is compounded of 13 chromosomes from the female and 26 chromosomes from the male parent.

3. The somatic mitosis has been described. The following details are of main importance: (*a*) The somatic chromosomes are very small and uniform. In the diploid 4 chromosomes may be identified by having a small satellite. (*b*) Chromatin and nucleoli show connexions in telophase, but their closer relationship has not been solved. (*c*) A tendency to a loosely paired arrangement of the chromosomes in somatic mitosis has been observed. A trace thereof is seen at metaphase where homologous chromosomes often are observed arranged together. (*d*) Only one nucleolus is observed in each nucleus during resting and prophase

stages in root-tips of diploids and the triploid and from tetraploid tissue, contrary to de Mol's observations from tulips.

4. Meiosis has been described from diploid *Gossypium arboreum* and the interspecific hybrid *G. herbaceum* × *G. arboreum*.

The following main observations may be cited: (*a*) The pachytene strands are double and have undoubtedly arisen from pairing of lepotene threads. (*b*) The pachytene strands are terminated by (1) free ends, (2) plasmasomes, or (3) end-to-end conjugation of two strands. (*c*) The number of pachytene strands is close to 13, which demonstrates that each strand represents a pair of whole chromosomes. (*d*) The stages leading from pachytene to metaphase represent a shortening and condensing. Traces of longitudinal fission in the single chromosomes may be seen at diplotene. The number of chiasmas is never more than three in each pair. Terminalization is not complete so that sub-terminal chiasmas are observed at metaphase. (*e*) *Gossypium arboreum* forms 13 pairs at metaphase, each having two terminal or sub-terminal chiasmas (rings). (*f*) The interspecific hybrid shows always at least one pair of chromosomes with no more than one chiasma (rod). (*g*) The second division is regular. The occurrence of chromosome plates with 12 and 14 chromosomes in the interspecific hybrid demonstrates that irregularities must have taken place during the first division.

5. The meiosis in the triploid is described in comparison with that of diploids. The following differences may be mentioned: (*a*) Pachytene strands composed of two and three threads have been described. Supposed univalent threads are noticed, and end-to-end conjugation of strands has been described. (*b*) The first metaphase shows, as expected from the observations of pachytene, a mixture of uni-, bi-, and trivalents. Furthermore, polysomes up to septavalents are found, and a number of bivalents plus trivalents ascending to 17 and 18 have been observed. The conjugations demonstrate that autosyndesis between the chromosomes in a set of 13 must take place. (*c*) The second division is regular, and shows that a distribution of all the chromosomes to two poles during the first division must have taken place in about 95 per cent. of cases. In the remaining 5 per cent. of cases three nuclei are formed, generally two big and a small one only containing 1 to 3 chromosomes. In two cases a fusion of the two chromosome plates during the second division has been observed. Pollen grains with 39 chromosomes are undoubtedly formed from such cases. (*d*) The chromosome numbers of 200 metaphases from the second division were counted. The results show that the distribution of the chromosomes to the two poles in the triploid Asiatic cotton is not the same as found in triploid *Datura* or triploid *Solanum*. In spite of the demonstrated autosyndesis more chromosome numbers were observed near to 13 and 26 than expected in case of a pairing of the 26 chromosomes and a random distribution of the remaining 13. The explanation is supposed to be an irregular distribution of the chromosomes from the polysomes.

6. The described observations are discussed in the light of the results of other workers.

7. The observed autosyndesis between the 13 chromosomes in Asiatic cotton may be the result of either (1) segmental interchange or (2) polyploidy. The polyploid explanation is favoured. Trisomes in a haploid New World cotton (unpublished work) and genetical data (unpublished) confirm the conclusion that the Asiatic cottons ($n = 13$) must be polyploids.

8. The possibility of producing tetraploid Asiatic cotton from the triploid is referred to.

450. Cotton Notes. (*Trop. Agriculture*, x., **1**, 1933, p. 6.) *The Inheritance of Lint Colours in Upland Cotton.*—In a review of this paper by J. O. Ware, Dr.

Harland writes as follows: "This paper contains an account of the mode of inheritance of lint colour in Upland cotton. The author points out that four shades of lint colour are present in Upland cotton. These are (1) dingy brown, borne by the Algerian Brown Lint variety, (2) bright green, borne by the Argentine variety, (3) yellowish brown, borne by the Nankeen variety, and (4) rust colour brown, borne by the Texas Brown variety. All four types were crossed with ordinary white, and the progenies studied. In each case the lint colour of the F_1 generation was intermediate between that of the coloured and white parent. In F_2 segregation occurred into an ordinary 1:2:1 ratio, and the results of subsequent generations confirmed the hypothesis that each of the four lint colours is a clear-cut mono-hybrid character. In certain cases the results were confirmed by back crosses to the recessives.

"A correlation was found in the case of the green variety between colour and fineness. The green lint variety possessed a fine and silky texture, and in F_2 the fine texture seemed to be completely linked with the green colour. In a review of the work of the Genetics Department of the Cotton Research Station, 1929 (Vol. VI., 1929, p. 304, of this REVIEW) the present writer called attention to the existence of two factor pairs for lint colour:

G^1—g^1	Green lint—white lint
K^1—k^1	Khaki lint—white lint

Experimental evidence was not presented in this review, but the existence of the correlation between green lint and fineness was alluded to: 'An interesting case of correlation was observed between G^1 (green lint) and lint fineness. The green segregates are invariably finer than the white. Whether this is physiological or genetic correlation is not yet known.'

"Lint colour in cotton may be white, dirty grey, various shades of brown or a green which rapidly fades to a rusty brown colour. A dirty grey occurs in some cottons of the Nanking type from Burma. Brown cottons of various shades also exist in the Old World group, and in New World cottons browns are represented in the three main groups of cultivated cottons, Upland, Bourbon, and Peruvian. The two wild species from Polynesia, *G. tomentosum*, Nutt., and *G. taitense*, Parl., also have brown lint. The most intensely pigmented type in our collection occurs in a Peruvian variety received from Ecuador under the name Pardo. No brown-linted varieties of commercial Sea Island are known, though there is considerable variation in the shade of cream. In Egyptian there is a very dark brown type (Enan's Brown), and the rest of the Egyptians vary between the rather strong pigmentation in commercial Uppers to the paler types, such as Pima and Sakel. Green of various shades is strongly developed in the variety Texas Green Lint, an Upland type evidently closely resembling the Argentine variety described by Ware.

"In reviewing previous work on the inheritance of lint colour the author points out the lack of agreement in the results of the lint colour investigations of other workers. In crosses between Upland and Egyptian, Balls stated that brown was not completely dominant over white, but gave an intermediate F_1. In the F_2 generation a 1:2:1 ratio was obtained, and plants with brown or white lint bred true up to the fifth generation. The intermediates continued to segregate as in the F_2 generation. Balls stated that among the extracted brown-linted plants, some individuals were much darker in colour than the original Egyptian.

"In the cross of Upland with white lint × Pima Egyptian with pale buff lint studied by Kearney, the F_1 was intermediate in colour, and the frequency curve of F_2 was uni-modal and symmetrical, although flatter than the curves for most of the characters studied. It appears, however, to the writer that Kearney

was not working with an Egyptian form possessing the factor for brown lint, but was really studying a cross between white and a dark cream containing plus modifiers for brown. The first paper on the inheritance of lint colour in Upland cotton known to the writer in which it is demonstrated that brown and white are allelomorphic is that of Thadani. In a cross between Texas Rust and a white variety, the ratio of 41 coloured to 14 white was obtained in F_2.

"The mode of origin of brown lint from the original wild prototypes may have an important bearing on the mode of inheritance of lint colour. Certain native races in Africa and also in South America prefer both brown and white cottons, as these can be used for making patterned fabrics. There would thus be a tendency to eliminate the intermediate grades of brown from the plant populations. Races which preferred white lint would presumably obtain this by selection against brown modifiers, unless, as in Upland, white is not affected by modifiers.

"The simplicity of inheritance of the main factor pair in inter-Peruvian crosses has not been found to apply in crosses of Sea Island White × Egyptian Brown studied at this Station. The F_1 is intermediate and the F_2 shows a series of at least ten different shades of brown with no clear line of demarcation between the classes. In further attempts to clear up this complex problem it was found that the cross of dark brown Egyptian × very light brown Pima gave simpler results than that of the Sea Island cross. It appeared, indeed, that the situation was analogous to that found in the inheritance of petal spot—namely, that the factor pair was not the presence and absence of the character—*i.e.*, brown and white—but dark brown and light brown. The brown Egyptian apparently contains a series of plus modifiers acting on a basal factor B_1, while the recessive, which although white in the absence of the plus modifiers, becomes intensified in their presence to a pale brown. Crosses between the heterozygote and homozygous brown give more clear-cut results than F_1 × white, presumably because the allelomorphic pair of characters, dark brown and light brown, are better shown up in the presence of the plus modifiers.

"Experiments to determine whether the gene for brown lint in Upland and Egyptian is identical have led to the conclusion that they are not, since crosses of Egyptian Brown × Upland Brown back-crossed with white, have given whites in about one-quarter of the population. This cross obviously involves duplicate genes for brown lint, and this case constitutes the third case of duplicate genes in New World cottons in which one member characterizes the Peruvian group and the other member the Upland group. Of the two chlorophyll-deficient genes, C_{ha} and C_{hb}, C_{ha} is characteristic of Peruvian and C_{hb} of Upland, though many Uplands also contain C_{ha}. One of the duplicate genes for red, R_1, is confined to the Upland group, and the other, R_2, to the Peruvian and Bourbon groups.

"Ware has established the existence of three different types of brown lint, each of which is allelomorphic to white. It appears that the factor pairs in Upland are brown and white, and not brown and less brown—*i.e.*, modifying factors apparently do not affect the expression of the recessive gene. It would be interesting to determine next the relationship between the various types of brown in Upland in order to determine whether duplicate genes are involved."—S. C. HARLAND.

451. CHROMOSOMES IN GOSSYPIUM AND RELATED GENERA. By A. E. Longley. (*J. of Agr. Res.*, xlvi., 3, 1933, p. 217.) Recent studies of the chromosome numbers in Gossypium made by the writer and by other investigators show the existence of two distinct groups—namely, the Asiatic group, in which the haploid chromosome number is 13, and the American group, in which the haploid chromo-

some number is 26. The separation of Gossypium species into two groups based on chromosome number corresponds with the general division of the species based on taxonomic characters.

This classification applies to the cultivated cottons, and does not take into account certain wild species of Gossypium. Two of these, *Gossypium davidsoni* and *G. harknessi*, although indigenous to North America, have 13 chromosomes, the number characteristic of Old World cottons.

It is customary to consider the diploid representatives of a group of plants as being more nearly related to the ancestral type than those forms having higher chromosome numbers. Five species, so isolated that there has been little opportunity for contamination with their close relatives, may be considered as representing most nearly the ancestral type. These are *Gossypium stocksi*, *G. sturti*, *G. davidsoni*, *G. harknessi*, and *Thurberia thespesioides*. The last, although usually considered as a separate genus, is very nearly related to Gossypium. All these species grow in more or less isolated localities, and hence may represent the primitive stocks from which the cultivated varieties of cotton have arisen. The fact that they have only 13 chromosomes indicates that 13 was the haploid and 26 the diploid chromosome number of the ancestors of our present-day cottons.

The double chromosome number found in the American cottons suggests a duplication of the chromosomes of an ancestral type. Cytologically this has not been demonstrated. If Gossypium species having 26 chromosomes are true tetraploids, simple Mendelian ratios should appear much less frequently in them than in the Asiatic group. Matsuura* has brought together the studies on inheritance in Gossypium. These show that about half of the characters studied in the American group segregate in a 3 : 1 ratio, while in the Asiatic group all but two characters studied are distributed in a 3 : 1 ratio. Such a method of comparison is not conclusive evidence of the duplication of chromosomes in all species with 26 chromosomes, but it at least suggests that the American species of Gossypium are tetraploid.

Many of the American cottons have had ample opportunity to cross with each other. It is possible that their high chromosome number has arisen through hybridization and that this new stock of vigorous hybrids has obliterated many of the ancestral types. If American cottons are both polyploid and crypt hybrids, it is to be expected that they will show the same difficulties of taxonomic classification encountered in many polymorphic genera, in which intermediate forms often bridge the gap between distinguishing specific characters.

Of the other genera of the Malvaceæ investigated, only Thurberia and Shantzia were found to have chromosome numbers suggesting a close relationship to Gossypium. The numbers in other Malvaceæ are, however, distinctive, and a critical study of representatives of other genera may lead to the discovery of chromosome numbers indicating relationships.

452. PRINCIPLES OF GENETICS: A TEXTBOOK, WITH PROBLEMS. By E. W. Sinnott and L. C. Dunn. (McGraw Hill Pubg. Co., Ltd., London, 1932. Price 21s. Abstr. from *Plant Breeding Abstracts*, iii., 3, 1933, p. 153.) This, the second edition of the book, has incorporated much of the new material which has been added to the science since the first edition appeared in 1925. The vast majority of the additions are centred round the new developments in cytology in its bearing on genetic phenomena; a new chapter on evolution has been added, very largely based on recent discoveries of chromosome behaviour, which have shed light on many of the problems of the early evolutionists. The section on biometry has also been suitably revised. The exposition of the general

* "A Bibliographical Monograph on Plant Genetics (Genic Analysis), 1900-25," Tokyo Imp. Univ., Bot. Inst., contrib. *Cytology and Genetics*, No. 82, 1929.

principles has remained substantially the same, although some of these have been illustrated by more recent and interesting examples. Some important questions, such as the inheritance of quantitative characters, still receive somewhat cursory treatment, and certain phenomena, such as heterosis, would appear to be not quite so straightforward as the authors' explanation suggests. Each chapter is, as before, furnished with a set of carefully devised and stimulating problems, together with an appropriate bibliography.

453. A TEXTBOOK OF GENETICS. By A. W. Lindsey. (The Macmillan Co., N.Y., 1932. Price 14s. Abstr. from *Plant Breeding Abstracts*, iii., **3**, 1933, p. 152.) Claiming as it does to be an elementary treatise on genetics, the present book nevertheless treats the subject from a very broad aspect. The development of the subject prior to Mendelism is traced, the enormous practical importance of genetics, especially in agriculture, is emphasized, and the general phenomena of reproduction are described. After a brief discussion of variation and the methods of study in heredity, the Mendelian Laws are expounded clearly and concisely, followed by the early evidence for the chromosome mechanism of inheritance, and on the nature and inheritance of sex. The position arising from the more recent observations on chromosome behaviour is discussed in a special chapter on the chromosome complex, and further in connection with interspecific hybridization. Many of the statements in the latter section have, however, ceased to apply rigidly since the production of balanced true-breeding hybrids. The application of genetics in plant breeding is also afforded a special chapter; here again the treatment is made with a view to the past rather than the future. The remaining chapters are devoted to animal and eugenic problems. Each chapter is furnished with a list of problems and a selected bibliography, and the whole volume with an admirable index and adequate illustrations.

FIBRE, YARN, SPINNING, WEAVING, ETC.

454. THE STAPLING OF COTTONS. By A. W. Bayes. (*J. of Text. Inst.*, xxiv., **2**, 1933, T. 90.) Describes a standard form which has been designed for recording all the results for the "Combined Stapling Test" on one sheet of paper.

455. IMMATURE AND AFTER-FROST COTTONS: CHEMICAL ANALYSIS. By A. W. Ssurowaja and P. P. Viktorov. (*Sa Rekonstrukziju textilnoi Promyschlennosti*, No. 5/6, 1932, p. 37. Abstr. from *Summ. of Curr. Lit.*, xiii., **5**, 1933, p. 112.) Immature cotton has a smaller cellulose content than mature cotton (81 : 94·5 per cent.); 20-day cotton is unsuitable for use as a textile raw material. Mature after-frost cotton possesses the necessary good qualities.

456. EFFECT OF ATMOSPHERIC HUMIDITY AND TEMPERATURE ON THE RELATION BETWEEN MOISTURE CONTENT AND ELECTRICAL CONDUCTIVITY OF COTTON. By A. C. Walker. (*J. of Text. Inst.*, xxiv., **4**, 1933, T. 145.) The data given in the paper show the effect of successive equilibrium humidity cycles on the relation between (*a*) relative humidity and moisture content, (*b*) insulation resistance and relative humidity, and (*c*) insulation resistance and moisture content, for raw and water-boiled cotton at constant temperature (25° C.).

457. TEST FOR CHEMICALLY DAMAGED COTTON FIBRES. By J. W. Lewis. (*J. of Text. Inst.*, xxiv., **3**, 1933, T. 122.) The following test for detecting damage due to acid or over-bleaching in cotton fibres has been frequently used for distinguishing between chemical and mechanical damage:

Small pieces of fibres are teased out gently on a microscope slide, care being taken not to damage the fibres with the needle, and are covered with a cover slip. A few drops of sodium zincate are run under the cover slip, the fibres left

for a few minutes till swelling is complete, and any excess liquid soaked off the slide with filter-paper. A few drops of water are then placed on the slide at one side of the cover slip, and are drawn underneath by filter-paper placed at the other side. Care is needed at this stage, as the water has a tendency to run round the cover-glass, and the fibres must be washed substantially free from zincate if the full effect is to be obtained.

Illustrations show the effect of the test on (i.) unscoured fibres, (ii.) fibres fully scoured and bleached, (iii.) fibres overbleached.

458. Impregnating Fabrics or Fibres against Puncture by Insects. By P. Nestler. (*Chem. Abs.*, **27**, 1933, 612. Abstr. from *J. of Text. Inst.*, xxiv., **4**, 1933, A. 216.) Fabrics for summer clothing are rendered puncture-proof to insects by impregnating with an aqueous emulsion containing 6 per cent. textile soap, 2 per cent. clove oil or bay oil, and 0·1 per cent. pyrethrum extract at 30° to 40° C.

459. Blow-room Treatment in relation to Leafiness in Cotton. By N. Ahmad. (*Ind. Cent. Cott. Comm.*, Leaflet 3, 1933.) Gives the results of subjecting particularly leafy samples of Porbunder cotton to different blow-room treatments with a view to reducing leafiness in its yarns. The results of the tests showed that intensified blow-room treatment was found to be slightly more effective than the normal treatment in removing the adhesive leaf from the fibre, but even with the most rigorous treatment adopted the resulting yarns were extremely leafy. The fibre was also damaged, and as a result the number of yarn breakages in the ring frame, especially in the higher counts, rose to an uneconomical figure, the yarns being less even and not so strong. In view of this, the only course to be recommended is greater care in picking the cotton.

460. Cotton Like Silk. (*Man. Guar. Coml.*, 25/2/33.) A production of the greatest importance to the Lancashire textile industry has recently been shown in Manchester; it marks a definite departure from the accepted principle of cotton, worsted, or similar fibred yarns, as for the first time twistless cotton yarns are now being produced on a commercial scale. The yarn, known as Rayallen yarn, is not twisted, but is prepared with every filament lying parallel to the others, and in this way the lustrous nature of each strand is fully maintained. Cloths prepared from the new yarns approach very closely to real silk in appearance, general handle, and in texture, and even after repeated laundering the lustre is unimpaired. This new development makes possible the production of cotton goods equal to silk, but at a cost below that of rayon, and there should naturally be a very wide market for the new yarn. Samples were also shown of tubular stockinette prepared from the yarn, and underwear made of this material is fully as soft and lustrous as garments made of real silk. Very severe tests have been made on the materials made from Rayallen yarn, but they have shown that dyeing and other finishing processes do not impair the strength, and the finished cloths are free from harshness, but at the same time are very strong. These yarns are the result of three years' research work.

461. Encyclopædia of Cotton Fabrics. By W. Hough. (John Heywood, Ltd., M/c. Price 3s. 6d. net. Abstr. from *Text. Rec.*, L., **600**, 1933, p. 69.) This small book of eighty-four pages has now reached its fifth edition, which can only be because the book is exceedingly useful. Its author spends an immense amount of time verifying and amplifying the detailed particulars of construction of the range of cloths which are given in his encyclopædia of cotton fabrics. These are arranged in alphabetical order. They cover the whole range of commercial cotton fabrics, and the practice has been uniformly followed of giving a brief

indication of the markets they are sent to, particulars of warp and weft, special characteristics in regard to colouring, types of headings and their most common uses.

462. Improving Handle and Lustre in Cotton Fabrics. "Minesta." (*Text. Rec.*, L., **600**, 1933, p. 55.)

463. Cotton Hair: Fineness. By — Lipowsky. (*Spinn. u. Web.*, **51**, **7**, **1933**, p. 1. Abstr. from *Summ. of Curr. Lit.*, xiii., **5**, 1933, p. 112.) Methods of determining the fineness of textile fibres are discussed, and the advantages of Johannsen's bundle method are pointed out. In the metric system fineness is given by the quotient of the length (l) and the weight (g). For a bundle of fibres of the same length the fineness of the individual fibres is given by the relation al/g. The method involves the preparation of a bundle of fibres of constant length and measurements of the weight and the number of fibres in the bundle. These operations are described. In order to determine the effect of spinning processes on the fineness of cotton hairs, tests were made on bundles taken from raw cotton, the card sliver, and the yarn. The tabulated data show that the spinning processes have no appreciable effect on the fineness of the individual hairs. The longer hairs were found to be finer than the shorter hairs. When using fineness determinations for assessing the spinning quality of cotton it is advisable to make microscopical examinations in order to discover if high degrees of fineness are due to the presence of immature hairs. Such hairs have low strength and poor dyeing properties.

464. Cotton Hair: Ripening and Dimensions. By O. Roehrich. (*Trans. Faraday Soc.*, **29**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **7**, 1933, p. 176.) Details are given of the author's methods for determining the measurable characters of cotton, and are illustrated by reference to an Adana cotton (Yerli-Koza), the bolls of which do not open on the plant, and a Pima cotton, also from Morocco. Staple diagrams made by the Baer sorter are reproduced, and notes are appended on the influence of roller and saw ginning on the staple and on nep formation. Support is given to the method of Calvert and Summers for measuring diameters (D in units of μ). A method is mentioned for determining hair weight per unit length, and from the data the weight in milligrams per 10 metres (P) is calculated. This is utilized to calculate the area of wall surface, S, from the equation $S = 100\ P/1{\cdot}5$, where 1·5 is the density of cellulose and the unit for S is μ^2. From D and S, the total surface, S^1, of the hair is calculated, thus, $S^1 = \pi D^2/4$, in μ, and finally a *coefficient of maturation* is obtained from $S \times 100/S^1$. A maturity count, based on mercerization, is also described, and the account of the tests is completed by reference to tensile tests on single hairs. In the discussion Miss Clegg pointed out the disadvantages of the coefficient of maturation; it would give a general figure but would not reflect those abnormalities of structure which might give rise to neps in spinning. P. Krais showed that if a tube of gelatine hardened by formalin is filled with water, closed at both ends, and then allowed to dry in the air, it convolutes somewhat like a cotton hair.

465. Hair Weight Determination Apparatus. By G. Krauter. (*Leipz. Monats. Text. Ind.*, **47**, 1932, p. 215. Abstr. from *J. of Text. Inst.*, xxiv., **2**, 1933, A. 107.) A bundle of cotton hairs is prepared by means of the usual type of staple drawing apparatus (*e.g.*, the Zweigle instrument), and then transferred to a device for counting. This consists essentially of two brass rods, 7 cm. long, which are placed parallel to each other and separated by a distance slightly less than the length of the hairs. The rods are covered with adhesive bands with the adhesive material on the outer surface. One end of the group of hairs is

attached to the top of one rod and the hairs are then stretched across the gap and their other ends fixed to the top of the other rod. The hairs are counted with the aid of a microscope or by means of some suitable counting device. A glass plate is then placed under the hairs in contact with them, and a second plate of exactly the same size is placed above. The two plates are fixed together by means of clips, and the projecting portions of the cotton hairs on each side are burnt with a sharp-pointed flame. Burning proceeds to the edges of the plates and the resulting sections of the hairs between the plates are equal in length to the plate width. The whole may be weighed and the weight of the hairs obtained by subtracting the weight of the plate and clips from the total, or the hairs may be removed and weighed on a suitable balance.

466. The Significance of Yarn Tests. By M. Caine. (*Text. Rec.*, L., **601**, 1933, p. 26.)

467. Cotton Yarn: Mercerization for Strength. By J. B. Wilkie. (*Amer. Dyes. Rep.*, xxii., **85**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **5**, 1933, p. 108.) The mercerization of cotton yarn was studied at the request of the U.S. National Advisory Committee for Aeronautics, with the object of determining the conditions for the production of yarn having the maximum strength for a given weight. Experiments were conducted under strictly controlled conditions varying the tension on the yarn, time and temperature of mercerization, and concentration of caustic soda. Yarns varying from 10's to 90's, some of them in a series of twists, were mercerized. A thorough pre-treatment of the yarns was found materially to increase their strength. The strength was further increased by mercerization, and the maximum increase was obtained by using sufficient tension to prevent the yarn from contracting in a caustic bath. The time and temperature of mercerization and the concentration of caustic need not be carefully controlled, though somewhat greater strength results when the concentration is low, say 10 per cent., and the temperature is kept at 0° C. or lower. The results indicate that the twist in the yarn must be low if the maximum increase in strength is to be obtained. The strength of properly selected yarns can be increased 50 per cent. or even 100 per cent. by pre-treatment and mercerization.

468. Cotton Yarn: Influence of Salts on Strength. By W. Neumann. (*Textilber.*, **14**, 1933, p. 84. Abstr. in *Summ. of Curr. Lit.*, xiii., **6**, 1933, p. 142.)

469. New Linen-Cotton Yarn. (*Man. Guar. Coml.*, 6/5/33.) The invention of a process for the "fusing" of cotton and linen is announced by the American Erlanger concern. Hitherto the combination of cotton and linen has been carried out mainly in the weaving operation, by the manufacture of cloth with, say, linen warp and cotton weft.

In the new process gelatinized flax and cotton are fused into one single substance, which is subsequently spun and which combines, it is claimed, the virtues of both fibres. The new yarn will soon be on the American market in the form of cloth and made-up household goods, which are to be marketed at prices above those ruling for cotton, but below those for linen. The process of converting the flax and cotton into the new substance has been patented by the Erlanger interests.

470. Textile Recorder Year Book, 1933. Gives, as usual, a great deal of statistical data, tables of production, etc., which are of much use for reference purposes. All the figures have been revised, and changes made whereby they are presented in more convenient form. The knitting section has been rewritten to include recent developments in the industry, and new sections have

been incorporated in connection with High Speed Winding and Warping, Nasmith combers, etc. A bibliography of new textile inventions introduced during the past year affords a useful reference to the new machines now available to the trade.

471. The European Textile Industry. By Dr. A. Niemeyer. (*Text. Rec.*, L., **600**, 1933, p. 31.) An analysis of the changes taking place in the industry in Europe as a result of expansion in the rest of the world.

472. The International Textile Industry. By Dr. A. Niemeyer. (*Text. Rec.*, L. **602**, 1933, p. 42.) Discusses the changes that have taken place in the last fifty years.

473. Cotton Baling Cloth: Advantages. By D. Marsden. (*Cotton* [U.S.], 97, **1**, 1933, p. 23. Abstr. from *Summ. of Curr. Lit.*, xiii., **6**, 1933, p. 126.) Cotton is sold in America on a gross weight basis, and there is a tendency to add to the weight of the tare in handling and marketing. The laws on tare in the different cotton States show wide variance; a synopsis of the laws is given. When cotton is sold on a true net weight basis, there is no incentive to add to the tare. Selling cotton on gross weight basis penalizes the farmer, even though he is led to believe that he is not penalized because he sells his bagging at a slight increase over costs. Normally, the Liverpool market is higher than the American market by approximately 5 per cent. This condition is attributed to the fact that Liverpool quotations are on a net weight basis, whilst American quotations are depressed by the gross weight basis. By an example it is shown that farmers would benefit by selling cotton on a net weight basis. It is also shown that, with an adequate tariff on jute, the use of cotton bagging instead of jute bagging for cotton bales would be advantageous. Strong light-weight cotton bagging is superior to jute bagging and burlap coverings, gives a neat package, and enables economies to be made in transport and insurance costs.

474. The Dust Hazard in the Cotton Industry. By — Koelsch. (*Arch. f. Gewerbepath. u. Gewerbehyg.*, 3, 1932, p. 399. Abstr. from *J. of Text. Inst.*, xxiv., **2**, 1933, A. 127.) The quantity of dust found in cotton mills may vary widely, as much depends on the kind and quality of the cotton, on the number of machines, and the effectiveness of the exhaust ventilation. Chinese cotton gives off most dust. Among organic impurities in the dust are to be found the remains of seed pods and parts of fungi, and an analysis of the dust from American cotton shows about 50 per cent. of SiO_2, and of the dust from Egyptian cotton about 29 per cent. Some of this was sand.

475. Richard Arkwright. By F. Nasmith. (*J. of Text. Inst.*, xxiv., **1**, 1933, P. 1.) An interesting account of the life-history of Richard Arkwright and of the conditions prevailing in the cotton industry when he commenced to take an interest in cotton spinning.

476. High Drafting: Its Economic Advantages. By C. Barnshaw. (*Text Rec.*, li., **602**, 1933, p. 35.)

477. A New Type Automatic Loom. (*Int. Cott. Bull.*, xi., **43**, 1933, p. 397.) Describes a new type of weft-replenishing motion invented by Mr. J. E. Moore, managing director of the Chain Bar Mill Co., Ltd., Manchester.

478. History of the Northrop Loom. (*J. of Text. Inst.*, xxiv., **4**, 1933, p. 71.)

479. Cotton Opening and Cleaning Plant. By J. Hetherington and Sons, Ltd., and L. Helmsley (Manchester). (E.P. 387,145 of 3/3/1932. Abstr. from *J. of Text. Inst.*, xxiv., **4**, 1933, A. 196.) Cylindrical openers of the " porcupine " or analogous type are mounted in series and in such a manner that the fibre bulk will pass from any opener direct to the next in a state of suspension along

a continuous path, whilst presenting each side of the bulk alternately to the usual opener grid bars. Good results are obtained with three openers rotatably mounted within a single casing, with the first and third on the same horizontal plane and the second on a higher plane. Each opener may rotate in the reverse direction to that of the preceding opener, and the speed of the openers may increase successively.

480. COTTON SPINNING MACHINERY DEVELOPMENTS. By H. Hill. (*Text. Rec.*, li., **602**, 1933, p. 29.) A record of improvements in cotton spinning from the bale to the finished yarn during the past fifty years.

TRADE, CO-OPERATION, ETC.

481. THE INTERNATIONAL TEXTILE SITUATION. By Dr. A. Niemeyer. (*Text. Rec.*, L., **601**, 1933, p. 24.) Deals briefly with the situation in Great Britain, France, Italy, Switzerland, Austria, Czechoslovakia, Poland, United States, and Japan. Irregular development is evident, for improvements in some countries are accompanied by declines in others.

482. HOW COTTON IS MARKETED. By A. Bryce Muir. (*The Accountant*, 8/4/33, p. 461.) This paper affords a most interesting insight into the operations of the cotton market. The author explains the system of hedging, which has made the cotton spinning business and cotton growing and merchanting business one that is worked to the finest margins of any trade in the world. Special attention is also devoted to the question of cotton futures, and the many problems and difficulties which confront those engaged in the cotton industry are discussed.

483. COTTON GOODS: WHOLESALE AND RETAIL PRICES. (1) By Sir Amos Nelson, (2) By A. P. Besley. (*Tcxt. Weekly*, **10**, 1933, pp. 528 and 553. Abstr. from *J. of Text. Inst.*, xxiv., **3**, 1933, A. 174.) A report of a debate. Sir Amos Nelson gave figures to show that he receives only 1¾d. per yard for weaving a high-class cotton cloth, whereas the converter gets 1½d., the merchant 2d., and the retailer 5½d. Besley replied by giving details of the services rendered by the retailer to account for the charge, and stated that a Government enquiry has revealed the fact that average distribution costs in England work out at 23 per cent., which is lower than the figure for other countries. Of this 23 per cent., wages absorb 55 per cent., and rent and rates about 6 per cent.

MISCELLANEOUS.

484. EMPIRE JOURNAL OF EXPERIMENTAL AGRICULTURE. (Oxford Univ. Press, London.) The first number of this new journal has now been issued, and contains the following among other articles: "The Breeding of Early-ripening varieties of Spring Wheat in Canada" (by L. H. Newman); "Residual Values of Leguminous Crops" (by H. Nicol); "Soil Surveys in Western Canada," Pt. I. (by A. H. Joel); "Grassland Management and its Influence on the Sward" (by M. G. Jones); "Soil Profiles from Cyprus" (by A. Reifenberg and E. K. Ewbank). The number is well furnished with diagrams and illustrations.

485. THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY. We have received a copy of the 25th Ann. Rpt. of the Governing Body for the year 1932. The year was marked by a steady development on established lines of the educational work of the College rather than by any marked change. The total number of students registered was 1,112, or 10 in excess of the previous year. Among the important changes resulting from proposals made by the Board of Studies were the institution of Fellowships of the Imperial College, and the institution

of additional Special Intermediate Examination facilities. The volume of the research work carried out during the year is mirrored in the number of Higher Degrees awarded to members of the staff and to students, which included 8 Doctors of Science, 49 Doctors of Philosophy, and 28 Masters of Science. The extended accommodation provided by the new building, completed in 1931, was much in demand, and all the 101 rooms were occupied during the session.

PERSONAL NOTES

It is with very great pleasure that we record the conferment of the honour of K.C.M.G. on the Director of the Corporation, Sir James Currie. Sir James Currie is also Chairman of the Governing Body of the Imperial College of Tropical Agriculture, Trinidad, and a Member of the Advisory Committee on Education in the Tropics.

We offer our sincere congratulations to Sir Percy Ashley on the honour of K.B.E. recently conferred on him. Sir Percy Ashley represented the Board of Trade on the Executive Committee and Administrative Council of the Corporation from its inception until 1932. He resigned from the Council on ceasing to be an officer of the Board of Trade, but has now accepted appointment as a co-opted member.

We also tender our congratulations to Professor Henry Ballou, Commissioner of Agriculture for the West Indies, and Professor of Entomology at the Imperial College of Tropical Agriculture, Trinidad, on the honour of C.B.E. conferred on him.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

British Guiana	Mr. E. M. Peterkin.
Gambia	Mr. F. W. Hall.
Gold Coast	Mr. W. H. Beckett.
,, ,, ...	Mr. A. W. Paterson.
,, ,, ...	Mr. F. A. Robb.
,, ,, ...	Mr. J. M. Ward.
,, ,, ...	Mr. T. L. Williams.

Gold Coast	Capt. J. M. Wingate.
India	Prof. W. Roberts.
Kenya Colony	Mr. D. L. Blunt.
,, ,, ...	Mr. E. L. Bradford.
,, ,, ...	Mr. D. C. Edwards.
,, ,, ...	Mr. E. W. Gaddum.
,, ,, ...	Mr. N. Humphrey.
Nigeria	Mr. A. G. Beattie.
,, ...	Mr. H. C. Doyne.
,, ...	Mr. O. T. Faulkner.
,, ...	Mr. A. V. Gibberd.
,, ...	Mr. J. L. Kincaird.
,, ...	Mr. E. H. G. Smith.
,, ...	Mr. A. E. Trotman.
,, ...	Mr. R. Turner.
,, ...	Mr. A. H. Young.
Nyasaland	Mr. F. Barker.
Northern Rhodesia	Mr. D. Stevenson.
Somaliland	Mr. R. A. Farquharson.
Tanganyika Territory	Mr. D. G. Burns.
,, ,, ...	Mr. E. Harrison.
,, ,, ...	Mr. A. S. Richardson.
,, ,, ...	Mr. F. H. Smith.
,, ,, ...	Mr. H. H. Storey.
,, ,, ...	Mr. D. Sturdy.
,, ,, ...	Mr. C. F. M. Swynnerton.
Uganda	Mr. P. Chandler.
,, ...	Mr. G. F. Clay.
,, ...	Mr. R. P. Davidson.
,, ...	Mr. A. J. Kerr.
,, ...	Mr. H. L. G. Milne.
,, ...	Mr. J. K. Shepherd.
West Indies: Trinidad	Mr. E. J. Wortley.
Zanzibar	Mr. J. V. R. Brown.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. W. L. Miller.
South Africa	Mr. P. A. Bowmaker.
,, ,, ...	Mr. S. Milligan.
Southern Rhodesia	Mr. W. L. Fielding.
,, ,, ...	Mr. A. N. Prentice.
Sudan	Mr. R. L. Knight.
Trinidad	Dr. S. C. Harland.

PRINTED IN GREAT BRITAIN BY
BILLING AND SONS LTD., GUILDFORD AND ESHER

THE
EMPIRE COTTON GROWING
REVIEW

VOL. X. OCTOBER, 1933. No. 4

TEN YEARS

THE present number completes ten years of the Review, and it is well worth while to look over the list of articles which during that time have appeared in it. They give a very fair representation of the work that has been accomplished by the Corporation, and enable one to get some idea of the progress that has been made.

When the Corporation began its work in November, 1921, and especially when the Review began to appear (January, 1924), the cultivation of long-staple (American) cotton within the Empire had been already started in many places, thanks mainly to the work of the British Cotton Growing Association; but as the statistics on p. 256 show, the total production of the various years (excluding India) since the inception of the Corporation has increased about 400 per cent.

When one remembers the great depression that has overhung all industry, of whatever nature, during the past few years, this result is gratifying to the Corporation, and it is clear that in the future the production of the Sudan, of Uganda, and of some other parts of the Empire, will have to be reckoned with upon the world's markets.

But when one works over the table in detail, one cannot but be disappointed with the results obtained in some places; by no means do all of them show such satisfactory results as those just quoted by name.

We have marked the maximum year's output for each place in heavy type, and it will at once be seen that the maximum by no means comes (in most cases) where one would like to see it—in 1931-32 or at least in the preceding year. When it is not more than, say, two or three columns back, the case may be simply an illustration of the fact that production per acre may vary considerably from year to year, so that even if in 1931–32 there was a greater area planted than in 1930-31, the crop might quite easily be less, owing to unfavourable

EMPIRE COTTON CROPS FOR THE YEARS 1920-32, EXCLUDING INDIA.

(In bales of 400 lbs.)

The seasons are given as covering two years (*e.g.*, 1926-1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Iraq, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

Country.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	1931-32.
(1) Anglo-Egyptian Sudan ..	30,519	24,074	28,306	47,652	44,912	121,131	148,118	126,115	161,536	157,769	120,310	**234,964** (1)
(2) Uganda ..	81,365	48,290	88,046	128,604	196,038	180,859	131,728	138,486	**204,057**	129,969	191,305	203,265 (2)
(3) Kenya ..	500	417	1,200	1,653	**2,250**	2,046	1,232	1,241	1,984	1,518	800	1,735 (3)
(4) Tanganyika ..	7,327	7,175	11,434	18,793	21,724	24,280	15,966	**32,954**	27,785	23,136	11,322	16,500 (4)
(5) Nyasaland ..	4,615	5,422	4,036	6,873	7,718	4,976	2,792	4,470	6,095	**9,331**	4,205	5,067 (5)
(6) N. Rhodesia ..	100	80	102	500	379	**506**	32	17	—	—	—	— (6)
(7) S. Rhodesia ..	—	—	—	1,650	4,907	**6,803**	639	90	280	1,481	1,974	579 (7)
(8) Union of South Africa and Swaziland	2,923	2,740	6,523	8,730	16,936	**20,381**	10,242	11,013	9,774	16,213	8,123	**2,801** (8)
(9) Nigeria ..	30,000	15,096	16,811	25,694	39,137	**47,909**	27,464	20,930	32,126	43,925	18,850	**6,268** (9)
(10) Gold Coast ..	61	49	15	93	1,132	**1,218**	285	264	296	200	297	**263** (10)
(11) Cyprus ..	2,547	1,505	2,233	3,397	3,320	4,614	2,110	2,146	3,610	**4,778**	2,827	**1,194** (11)
(12) Malta ..	582	193	118	573	**782**	507	342	541	379	293	201	**41** (12)
(13) Iraq	60	300	1,100	2,400	2,540	3,500	1,800	**5,200**	4,700	3,300	960	**409** (13)
(14) Ceylon ..	—	—	49	324	121	261	186	202	**380**	248	95	**52** (14)
(15) Queensland ..	792	3,140	9,344	11,850	**14,318**	7,179	5,880	10,266	6,296	13,999	12,228	**4,975** (15)
(16) Fiji	—	—	85	157	123	**824**	356	114	271	398	266	**90** (16)
(17) West Indies ..	4,763	4,314	5,295	4,309	4,186	5,941	**6,076**	4,088	5,312	5,672	5,106	**2,524** (17)
	166,154	112,795	174,697	263,252	360,523	432,935	355,248	358,137	464,881	412,230	378,869	480,727
		Percentage Decrease **32·1.**	*Percentage Increase* **54·8.**	*Percentage Increase* **50·6.**	*Percentage Increase* **36·9.**	*Percentage Increase* **20·0.**	*Percentage Decrease* **17·9.**	*Percentage Increase* **0·8.**	*Percentage Increase* **29·8.**	*Percentage Decrease* **11·3.**	*Percentage Decrease* **8·1.**	*Percentage Increase* **26·8.**

conditions of some kind. But when the gap is greater than two or three years, and when, as is not uncommonly the case, the production of 1931-32 does not come within even 30 or 40 per cent. of the maximum, this explanation will hardly suffice, and some other must be sought. The obvious one, that the area planted in those particular countries is not increasing, may not be the whole truth, and even if true may require further explanation. There may be one or more of many factors at work to produce the very evident result: there may be greater profit in other crops; the cottons so far grown may not be really well suited to the locality; there may be extra liability to some disease (like blackarm) or pest (like jassid); there may be lack of interest among the people; there may be difficulties of transport so great as to make the cost prohibitive, and so on. A short account of the obstacles which have prevented cotton from becoming a commercial success in certain countries would prove an interesting addition to the journal, and would also be very useful in helping to indicate lines that should be followed in carrying on further work for the extension of cotton cultivation in the areas in question.

The position of cotton-growing in the Empire was summed up in a paper by Mr. Killby:

> Cotton Growing within the British Empire, i., 1924, pp. 161, 261; and *cf.* Cotton Growing in the Empire, i., 1924, p. 81;

and a revision of this paper to a later date would be a useful contribution to our pages, though for it to be completely informative we still need explanation (as mentioned above) of the non-progress of cotton cultivation in certain countries.

Leaving India out of consideration, practically the whole of the Empire's long-staple cotton, except Sea Island, is grown within the limits of Africa, the 1931-32 figures being, for British Africa (as a whole, but excluding Egypt), 471,442 bales, and for the rest of the Empire (excluding India), 9,285 bales. This fact is reflected in the Journal in the corresponding feature that the bulk of the contributions relate to Africa. General accounts of the cultivation of cotton in most parts of Africa have been given in the following series of articles:

Williams and Symond: Cotton Trials in Northern Territories, Gold Coast, VIII., 1931, p. 95.

Lamb: The Past, Present, and Future of Cotton Growing in Nigeria, II., 1925, p. 184.

Lewin: The Improvement of Cotton in Southern Nigeria, IV., 1927, p. 224.

Smith: Notes on Clothing, Cloth, and Cotton in the Lower Niger, V., 1928, p. 134. Markets and Marketing in Nigeria, VI., 1929, p. 315.

BROWNE: The Experiment in Co-operative Farming at Daudawa, Northern Nigeria, VII., 1930, p. 278.

FAULKNER: Mixed Farming and Cotton Production in Northern Nigeria, X., 1933, p. 1.

LEE: Cotton Buying in Nyasaland, II., 1925, p. 10.

PONSONBY: Cotton in Nyasaland, III., 1926, p. 322.

DUCKER: Cotton in Nyasaland, VI., 1929, p. 326, and IX., 1932, p. 192.

SALTER: Cotton Growing in Northern Rhodesia (Report 1925-26), IV., 1927, p. 118.

NOBBS: Southern Rhodesia, II., 1925, p. 81.

CAMERON: Cotton Growing in Southern Rhodesia (Report 1924-25), III., 1926, p. 147, and (1925-26) IV., 1927, p. 121.

CAMERON: Outlook for Cotton in Southern Rhodesia, VIII., 1931, p. 83.

EDWARDS: Cotton in Sierra Leone, VII., 1930, p. 91.

PORRITT: A Trip through Uganda and the Sudan, I., 1924, p. 281.

A Newcomer to the Sudan Cotton Fields, I., 1924, p. 116.

HUDDLESTON: Rain Cotton Development in the Sudan, II., 1925, p. 1.

HODGKINSON: Development of Cotton Land on the Gezira Plain, II., 1925, p. 337.

HEWISON: Cotton Growing in the Southern Sudan, III., 1926, p. 313, and V., 1928, p. 1.

BLUEN: Cotton Growing under Irrigation in the Sudan, VIII., 1931, p. 1.

HEWISON: Rainfall and Cotton Yields in the Gezira, VIII., 1931, p. 290*a*.

KEATINGE: Cotton Growing in South Africa, III., 1926, p. 193.

KEMP: Speech on the Opening of the Louis Trichardt Cotton Ginnery (Transvaal) on October 8, 1925, III., 1926, p. 81.

HESSE: Co-operation in South Africa, IV., 1927, p. 337.

FIELDING: A South African Farming Chronicle, IX., 1932, p. 291.

WOOD: Cotton in Swaziland, IV., 1927, p. 18.

KEATINGE: Swaziland Revisited, VI., 1929, p. 298.

WOOD: Cotton in Tanganyika Territory, I., 1924, p. 31.

Cotton in Tanganyika, I., 1924, p. 44.

WOOD: Report on Experimental Work with Cotton, Tanganyika, II., 1925, p. 14.

WAKEFIELD: Cotton Experiments in Tanganyika Territory under Riverine Conditions, VIII., 1931, p. 16.

KIRBY: The Progress of Cotton Growing in the Tanganyika Territory, VII., 1930, p. 169.

HARPER: A Review of the Work of Cotton Seed Selection in Uganda, Years 1911-25, III., 1926, p. 24.

KILLICK: A Newcomer's Impressions of Uganda, III., 1926, p. 47.

NYE: A Short Account of the History and Development of Cotton in Uganda, VIII., 1931, p. 282.

Problems of a more general nature relating to Africa are discussed in:

The Extension of Railways in Tropical East Africa, I., 1924, p. 85.

FRENCH: The Transport of Cotton in Africa, I., 1924, p. 225.

MARTIN LEAKE: Some Thoughts on Land Tenure in Tropical Africa, I., 1924, p. 240.

CROWTHER: The Soils of Tropical Africa, II., 1925, p. 35.

SAMPSON: An Attempt to solve some of East Africa's Cultivation Problems, II., 1925, p. 317.

SAMPSON: The Native Cotton Industry and its Relation to Rural Economy in the British Colonies of East Africa, IV., 1927, p. 29.

In addition to the articles mentioned of a more general kind there have been a considerable number dealing with parts of the subject in greater detail. For example:

POMEROY: The Relative Importance of Insect Damage as a Factor in Inhibiting the Production of Cotton in Southern Nigeria, III., 1926, p. 36.

BALLS: The Perfect Control of Cotton Seed, III., 1926, p. 331.

TAYLOR: Irrigation and Crop Production, V., 1928, p. 100, and Note by Sabet, V., 1928, p. 323.

Cotton Fertilizer Experiments in South Africa, III., 1926, p. 165, V., 1928, p. 165 and VI., 1929, p. 53.

DUCKER: Working Cattle in Nyasaland, VII., 1930, p. 1.

SMITH: Bush Paths and Roads in Nigeria, VIII., 1931, p. 218.

FAULKNER: Mixed Farming and Cotton Production in Northern Nigeria, X., 1933, p. 1.

But Africa, though easily first in importance, is not the only part of the Empire to grow long-staple cotton, and we have had a number of papers dealing with the work done elsewhere:

NOBLE: Cotton Growing in Cyprus, IV., 1927, p. 103.

ANSON: Cotton and Guns, V., 1928, p. 146.

EASTWOOD: Cotton Growing in Iraq, VIII., 1931, p. 178.

STOCKDALE: Cotton in Ceylon, VI., 1929, p. 101.

EVANS: Cotton Prospects in Papua, III., 1926, p. 200.

EVANS: Report on Cotton Growing Possibilities in the Territory of New Guinea, III., 1926, p. 215.

EVANS: Cotton Growing Prospects in Fiji, III., 1926, p. 1.

ANSON: Cotton Growing in Fiji: First Progress Report, IV., 1927, p. 105.

ANSON: The Schemers (Fiji), IX., 1932, p. 207.

EVANS: Queensland Cotton Growing, II., 1925, p. 169.

EVANS: The Future of Cotton Growing in Queensland, III., 1926, p. 87.

TODD: Sea Island Cotton: A Revival of Interest, VII., 1930, p. 98.

India, though it has its own Indian Central Cotton Committee, has not been altogether left out of consideration, and the following articles, which give a fair idea (when taken with the abstracts given in the Notes on Current Literature) of what is going on, may be mentioned.

India, thanks to her great available cotton area and her vast labour supply, may easily become the source of very great supplies of good long-staple cotton if once the handicap of her short growing season can be overcome by the discovery of some new kind of cotton

bred to suit the climate and conditions, or by some improvement in methods of cultivation, or in irrigation, etc.

BURT: The Indian Central Cotton Committee, I., 1924, p. 25.
BARBER: Cotton Growing in Madras, II., 1925, p. 100.
YOUNGMAN: Oomras Cotton: The Problem of the Short Staple, II., 1925, p. 309.
BURT: Recent Progress in Cotton Growing in India, IV., 1927, p. 93.
TROUGHT: Cotton in the Punjab, V., 1928, p. 228.
YOUNGMAN: Musings in a Monsoon Climate, VI., 1929, p. 35.
ROBERTS: Introduction of American Cotton in the Punjab, VII., 1930, p. 181.
ROBERTS: Crop Failures and Mixing of Punjab American, VII., 1930, p. 275.
HIMBURY: Paths of Loneliness, VII., 1930, p. 287.
MILNE: American Cotton in the Punjab, VIII., 1931, p. 23.
HOWARD: The Improvement of Cotton Production, IX., 1932, p. 89.
HENDERSON: John Bright and Indian Cotton, X., 1933, p. 189.
HOWARD: The Periodic Failure of American Cotton in the Punjab, X., 1933, p. 268.

As has been pointed out elsewhere (Willis: "Agriculture in the Tropics," 1909), there are a number of primary factors which must be kept in good working order, or agricultural progress cannot be made: such are land (in the broad sense), crops (here cotton is the only one), transport, labour, and especially finance.

The question of land tenure, and especially of the possibility of Europeans obtaining in some form that use or control of the land which would render possible the cultivation of cotton or other crops under the supervision that is needful if the best results are to be obtained (and incidentally which would make it worth while putting European capital into the affair), has been considered in a few articles:

MARTIN LEAKE: Some Thoughts on Land Tenure in Tropical Africa, I., 1924, p. 240.
MARTIN LEAKE: The Case for Chartered Companies, X., 1933, p. 173.
FRENCH: Some Notes on Large Estate Farming in the Punjab, and on the Possibility of Encouraging Similar Developments in Tropical Africa, II., 1925, p. 299.

The second is an especially interesting and important article, pointing out how the work can be done by a Chartered Company without the exploitation of the natives which has unfortunately become associated with the popular idea of such enterprises.

Turning to subjects more directly associated with the cultivation of the land itself, a phenomenon which is only too familiar to all who have to do with those countries in the tropics—and elsewhere—which were early cleared of forest, is the great amount of erosion, and the great damage to the land that is caused thereby. The importance of

this subject is at long last being more fully realized, and we have had one or two papers dealing with it, notably:

Soil Erosion, VI., 1929, p. 295.

DUCKER: Soil Erosion Problems of the Makwapala and Port Herald Experiment Stations, Nyasaland, VIII., 1931, p. 10.

HOWARD: The Improvement of Cotton Production, IX., 1932, p. 89.

In this connection, and leading on to the next subject, we may point out that Mr. Howard's paper contains an account of his method of preparing a humus manure from all the refuse that naturally occurs about a farm—a method that is now being largely tried (chiefly in India, where it originated), and which bids fair to cause considerable changes for the better in the agricultural economy of poor countries.

In countries like the United States, and in those like India, where cotton has been grown upon a large scale for a long time, it has usually been too often grown upon the same ground without a proper variation (or even mixture) of crops, or without sufficiently manuring the land, so that the tendency has been towards a steady diminution in yield. (Compare the yields of the two countries just mentioned with the enormous crops from the comparatively new soils of Brazil, Peru, and many places in Africa.) There is no doubt that for a crop that, like cotton, is chiefly handled by poor and comparatively ignorant cultivators, the best way of getting over this disadvantage is by the method of rotation of crops practised in Europe as early as Roman times. Probably a still further advantage might be gained by the practice of green manuring as used especially by the Tamil cultivators of South India and North Ceylon. But a definite effort to put the Empire crops, at least, upon a rotational basis is now being made, as may be seen in recent reports of the Experiment Stations maintained by the Corporation. The only paper to appear in the Review definitely dealing with rotation is:

FIELDING: Rotation Crops, X., 1933, p. 111.

Papers dealing with technical details of cultivation and things connected with it have been fairly numerous; among them we may mention:

SAWHNEY: A Method of Propagating Varieties of Cotton from very Small Amounts of Seed, II., 1925, p. 42.

Cotton Grading, II., 1925, p. 117.

BALLS: The Best Field Method for sowing Cotton, II., 1925, p. 241.

ENGLEDOW and YULE: The Principles and Practice of Yield Trials, III., 1926, pp. 112, 235.

HARLAND: A Note on the Vegetative Propagation of Cotton Plants, IV., 1927, p. 53.

CROWTHER: Chemical Aspects of Soil Cultivation, IV., 1927, p. 206.
PARSONS: The Thinning Operation in Cotton Growing, IV., 1927, p. 344.
THOMAS: Cotton Picking by Machinery, IV., 1927, p. 352.
THOMAS: The Round Bale, V., 1928, p. 17.
MARTIN LEAKE: The Moisture Requirements of Tropical Crops, V., 1928, p. 212.
KENCHINGTON: Note on Adventitious Bud Formation in Cotton, VI., 1929, p. 246.
TROUGHT: Notes on . . . Vicinism and Artificial Pollination in Egypt, VII., 1930, p. 13.
BARRITT: Plant Development Curves and the Branching of Cotton, VII., 1930, p. 114.
TROUGHT: A Handy Form of Nomograph for calculating the Ginning Outturn of Single Plants, VIII., 1931, p. 118.
PARNELL: Good Picking, X., 1933, p. 282.

Suitable crops as a general factor must in our case be translated into " cotton, when it will grow and bear freely." But there are cottons and cottons: not only have outside varieties to be tried in most places—for cotton is a newcomer in much of the Empire—but also local varieties, suitable (or more suitable) to the local conditions, may be produced, and much of this work is being done.

The Russians on the whole have led the way in the improve-

HURST: The Russian Experiments in Plant Breeding, IX., 1932, p. 4.

ment of varieties by getting together as far as possible all known varieties of the different crops with which they are working. In this way they have at hand gametes or sexual cells bearing any of the known characters of cotton, and by suitable crossing can breed into the new varieties produced any character that may be desired, and may also drop out or replace undesirable characters. This is the kind of work that Dr. Harland is carrying on at the Corporation's Experiment Station in Trinidad, and, given the necessary time—an all-important factor in work like this, where many successive generations are often required before a satisfactory result can be obtained, and perhaps as many more after it has been obtained before the new variety can be distributed—great results may be expected.

One of the most striking results of the work done under the auspices of the Corporation in the way of breeding has been the production of U4 in South Africa. Previous to its creation, the jassid was so destructive that cotton was practically impossible as a crop; now the jassid is reduced to manageable proportions, while at the same time the new cotton is better than the old. Great credit is due to Mr. Parnell for this successful piece of work. Other successful work has been done with the Uganda cottons and with others, and it is clearly evident that breeding has a great future before it.

HARLAND: Yielding Power of Pure Strains of Sea Island Cotton compared with that of Commercial Varieties, II., 1925, p. 136.

BURD: Research Work in St. Vincent, II., 1925, p. 225.

PARNELL: The Breeding of Jassid-Resistant Cottons, II., 1925, p. 330.

BROWN: The Improvement of Uppers, V., 1928, p. 242.

PARNELL: The Cotton Breeding Station at Barberton, V., 1928, p. 315.

SENNITT: Maarad Cotton, VI., 1929, p. 27.

Methods of Selfing Cotton Flowers, VI., 1929, p. 44.

BROWN: Some Broader Aspects of Cotton Breeding, VII., 1930, p. 196.

HURST: Speeding up Plant Breeding, VIII., 1931, p. 103.

HURST: The Russian Experiments in Plant Breeding, IX., 1932, p. 4.

HOWARD: The Improvement of Cotton Production, IX., 1932, p. 89.

BROWN: The Purity Chequer in Plant Breeding, IX., 1932, p. 119.

PEAT: The Cotton Breeding Station, Gatooma, IX., 1932, p. 199.

HARLAND: The Acclimatization of Cottons in New Areas, IX., 1932, p. 285, and X., 1933, p. 206.

HARLAND: The Sixth International Congress of Genetics, X., 1933, p. 17.

HURST: Progressive Evolution, X., 1933, p. 195.

BROWN: Purity and Variability in Cotton, X., 1933, p. 108.

Diseases and pests, which take so tremendous a toll upon our cultivated crops, and perhaps even more than usual upon cotton, which is a member of a large and widespread family, have received a great deal of attention from the staff of the Corporation and others. In addition to very numerous references in the Notes on Current Literature, we have published the following articles dealing directly with these subjects:

LEFROY: Insect Pests of Cotton, I., 1924, p. 196.

BALLOU: Insect Pests and Cotton Development, II., 1925, p. 323.

KING: Notes on the Red (Sudan) Bollworm in Nyasaland, III., 1926, p. 352.

JONES: The Pathology of the Cotton Plant in Nigeria, IV., 1927, p. 36.

KING: Applied Entomology in Relation to the Agricultural Resources of a Country, IV., 1927, p. 137.

BALLARD: The Entomological Problems of Queensland Cotton Growing, IV., 1927, p. 196.

MYERS: The Biological Control of Cotton Pests, V., 1928, p. 113.

GOLDING: The Control of Cotton Stainers in Southern Nigeria, V., 1928, p. 128.

HANSFORD: Cotton Diseases in Uganda, 1926-28, VI., 1929, pp. 10, 160, 240.

MASSEY: Blackarm Disease of Cotton, VI., 1929, p. 124.

FAHMY: The Angular Leafspot of Cotton in Egypt, VII., 1930, p. 30.

FINDLAY: Bacterial Diseases of Cotton, V., 1928, p. 29.

Treatment of Cotton Seed by Sulphuric Acid, V., 1928, p. 239.

NYE: Some Results obtained from the Sulphuric Acid Treatment of Cotton Seed, VI., 1929, p. 50.

GOLDING: A Vector of Leafcurl in Southern Nigeria, VII., 1930, p. 120.

MASSEY: Studies on Blackarm Disease of Cotton, VII., 1930, p. 185, and VIII., 1931, p. 187.

THOMAS: Extermination of Locusts by Aeroplane, VIII., 1931, p. 121.
HANSFORD: Blackarm Disease of Cotton in Uganda, IX., 1932, p. 21.
MASSEY and ANDREWS: Leafcurl Disease of Cotton in the Sudan, IX., 1932, p. 32.
HOPKINS: Some Diseases of Cotton in Southern Rhodesia, IX., 1932, p. 109.
HEWISON: Blackarm Disease in the Gezira, IX., 1932, p. 276.
PAGE: Improvements in Fumigation, X., 1933, p. 11.
BUTLER: Cotton Diseases, X., 1933, p. 91.
WILLIAMS: The Bollworms of Cotton, X., 1933, p. 273.

Transport, again, is a subject of the very greatest (and primary) importance in agriculture. We have had the most primitive type described in:

SMITH: Bush Paths and Roads in Nigeria, VIII., 1931, p. 218;

and the following articles on more up-to-date methods:

The Extension of Railways in Tropical East Africa, I., 1924, p. 85.
FRENCH: The Transport of Cotton in Africa, I., 1924, p. 225.
BAILLIE, BRACKENBURG, and FRENCH: Recent Developments in Mechanical Transport Suitable for Use in Tropical Dependencies, IV., 1927, p. 281.
MAY: Oversea Mechanical Transport, X., 1933, p. 286.

Much money is now being expended upon the extension of transport facilities in Africa, which in this respect is far behind India or the United States.

In the long run, all agricultural progress hinges upon finance, and we venture to suggest that the problem of financing village cultivators in all parts of the Empire should be fully enquired into. In this connection we may mention:

BROWN: Cotton Price Stabilization, VIII., 1931, p. 30.
Markets, VIII., 1931, p. 173.
TODD: The World's Cotton Markets, VIII., 1931, p. 291.
HALL: Agriculture as an Industry, IX., 1932, p. 269.
TODD: The World's Cotton Supplies, X., 1933, p. 81.

Scientific research, which when the writer first obtained a position in which it might be applied to practical matters of agriculture, was derided by the "practical man," has now come into its own, and forms an essential basis of all progress. Travelling up from Cambridge a short time ago in a carriage full of farmers who were discussing the depression, we were rather amused to hear one of them say: "It is all these confounded researchers that have done it," while another added that there were too many middlemen: "I produce at 1s. a dozen, and I see 'em in the shops at 3d. and 4d. apiece—there's something wrong there."

Apart from very numerous articles in which the results of research are described or mentioned, and from articles that contain research

only, we have published many that deal in a general way with research and its possibilities, *e.g.*:

BALLS: Cotton (a popular lecture), I., 1924, p. 94.
BARRITT: " Worn out " Cotton Varieties, I., 1924, p. 214.
BALLS: The Weights and Measures of the Cotton Hair, II., 1925, p. 108.
HILSON: The Improvement of the Cotton Crop, II., 1925, p. 201.
FARMER and KILLBY: Report on Trinidad as a Site for a Central Cotton Research Station, II., 1925, p. 279.
HARLAND: An Account of the Programme of Work of the Genetics Department, Cotton Research Station, Trinidad, IV., 1927, p. 325.
The Imperial Agricultural Research Conference, V., 1928, p. 161.
MASON: Note on the Work of the Physiology Department, Cotton Research Station, Trinidad, V., 1928, p. 298.
HEWISON: Scientific Research and Agricultural Departments, V., 1928, p. 302.
RUSSELL: Applications of Science in Agriculture, VI., 1929, p. 1.
MARTIN LEAKE: Research and Agriculture, VI., 1929, p. 115.
HARLAND: The Work of the Genetics Department, Trinidad, VI., 1929, p. 304.
Harvesting the Results of Research, VII., 1930, p. 85.
The Conference of Cotton Workers, VII., 1930, p. 261.
Jealott's Hill, an Empire Research Station, VIII., 1931, p. 26.
The Invocation of Natural Selection, VIII., 1931, p. 277.
HOWARD: The Improvement of Cotton Production, IX., 1932, p. 89.
HALL: Agriculture as an Industry, IX., 1932, p. 269.

Much help has come to the Corporation in its work from various outside bodies, and their activities have been described in a number of articles—*e.g.*:

WATTS: The Imperial College of Tropical Agriculture, I., 1924, p. 15;
ASPINALL: The Imperial College of Tropical Agriculture, X., 1933, p. 165;

two articles which show the great progress that has been made by the College, of which Sir James Currie is now the Chairman of the Governing Body, and at which many of the students financed by the Corporation receive part of their training. In this connection we may mention:

CURRIE: The Functions of an Agricultural Officer in the Tropics, VI., 1929, p. 109.

Two other articles:

NEAVE: The Work of the Imperial Bureau of Entomology, I., 1924, p. 191;
BUTLER: The Work of the Imperial Bureau of Mycology, II., 1925, p. 30;

show the work that is done by these two very useful Government Bureaux, to which one is accustomed to apply for help in all cases of difficulties connected with the attacks of insect pests or of fungus diseases respectively.

Spinning tests, of new cottons that have been produced by officers who work at the breeding of new and improved varieties, form a very important item in the outside help received. They are usually carried out by the British Cotton Industry Research Association at the Shirley Institute near Manchester, and the following articles (besides references in the Notes) deal with some of this important work:

Brokers' Reports and Spinning Tests upon Samples of Tanganyika Cotton, I., 1924, p. 42.

Spinning Tests, Indian Cottons, II., 1925, p. 129.

Spinning Tests, Uganda Cottons, II., 1925, p. 215.

Spinning Tests, Indian Cottons, III., 1926, p. 374.

SUMMERS: The Work of the Shirley Institute in Relation to Cotton Growing, IV., 1927, p. 20.

TURNER: Technological Reports on Standard Indian Cottons, IV., 1927, p. 298.

TURNER: The Indian Central Cotton Committee Technological Laboratory, VI., 1929, p. 215.

TODD: Classification of the World's Cotton Crops, IX., 1932, p. 46.

Spinning Tests, IX., 1932, p. 261.

An object always kept in view has been to make the journal a means of liaison between those concerned with the growing, breeding, and sending to market of cotton, on the one hand, and the purchasers in the market, who spin, weave, and manufacture the cotton, on the other hand. The better that each of these two groups understands the work of the other—and especially what he can, and what he cannot, do—the better will it be for progress, a progress which will make things more easy for the manufacturer as well as for the grower.

A number of articles have been specially written by people concerned with the manufacturing side of the subject to give the cultivator and the breeder an idea of what goes on in such a country as the Lancashire cotton districts—*e.g.*:

NICKSON: The Marketing of American Cotton, I., 1924, p. 88.

TURNER: The Spinning Value of Cotton, I., 1924, p. 107.

SAMPSON: An Account of a Tour through Portions of the Cotton Belt of America, I., 1924, p. 178.

SPEAK: Cotton Weavers' Desire for More Cotton, I., 1924, p. 186.

MUIR: Liverpool Cotton Futures Contract, II., 1925, p. 198.

BROWN: An Account of a Tour through the Eastern Section of the Cotton Belt of America, III., 1926, p. 268.

NICKSON: The Liverpool Cotton Association, III., 1926, p. 307.

Low Prices for Cotton, IV., 1927, p. 1.

ROBINSON: Manchester's Raw Cotton Market, IV., 1927, p. 10.

UNDERWOOD: Cotton Spinning and the Cotton Grower, IV., 1927, p. 181.

Neppiness in Cotton, V., 1928, p. 97.

The Cotton Industry Act, V., 1928, p. 209.

SPIBEY: Ginning Technique and Cotton Quality, VII., 1930, pp. 104, 202.
BARRITT: The Determination of Fineness of Egyptian Cotton and its Relation to Quality, VII., 1930, p. 19.
Halo Length Measurement, VIII., 1931, p. 214.
TODD: The Classification of the World's Cotton Crops, IX., 1932, p. 46.
TODD: The World's Cotton Supplies, X., 1933, p. 81.

Dealing with statistics has throughout been in Mr. Todd's capable hands, and articles appear regularly in every number—in the following arrangement:

JANUARY—Consumption and Stocks. APRIL—World's Crops: America and Egypt. JULY—World's Crops: India. OCTOBER—Comparative Cotton Prices.

The following historical articles are worthy of mention:

BALLS: James Wanklyn McConnell, I., 1924, p. 7.
BURD: William Robson, I., 1924, p. 10.
History Repeats Itself, V., 1928, p. 295.
Indian Cotton: the Webs of Dacca, VI., 1929, p. 231.
Loading Cotton on the Alabama River, VII., 1930, p. 129.
HENDERSON: Empire Cotton during the Cotton Famine of 1861-4, IX., 1932, p. 53.
HENDERSON: The Cotton Supply Association, 1857-72, IX., 1932, p. 132.
HENDERSON: John Bright and Indian Cotton, X., 1933, p. 189.

We have also included in our pages a number of popular or semi-popular articles, by Mrs. Penny, the well-known novelist, W. Gilhespy, J. C. May, and others.

THE PERIODIC FAILURE OF AMERICAN COTTON IN THE PUNJAB

BY

ALBERT HOWARD, C.I.E., M.A.,

Formerly Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India and Rajputana.

DURING the last fifteen years the cotton crop of the Punjab has frequently suffered either from partial or almost complete failure. American cotton is affected much more severely than the indigenous varieties. Yet even in the worst years there has been no destruction of the cotton plants themselves. Growth and development are always normal except in one respect—the flowers do not set properly: little or no seed is produced. There is every gradation between an average cotton crop and almost complete failure. In the worst years few of the anthers burst, very little pollen is produced, with the result that a very small number of bolls develop. When matters do not reach this extreme stage, a good deal of actual setting may take place, but the bolls open with great slowness and the fibre lacks life and strength. Such damage is not absolutely universal: plants partly protected by wind-breaks are found to suffer considerably less than the ordinary exposed crop. The bolls of these sheltered plants open more normally and the fibre is stronger. Even in the most favourable seasons, however, the American cotton crop in the Punjab gives one the impression that it is not quite at home. The plants seem to hang fire as the crop ripens and there is a marked tendency for the picking period to be unduly prolonged. There is nothing approaching that rapid development so characteristic of the cotton crop on the black soils where the plants seem to rush towards harvest and literally to break into a mass of seed-cotton. In this tract, where the bulk of the Indian cotton crop is produced, most of the fibre is collected in two pickings and the harvesting period is short.

A good deal of research has been devoted to the discovery of the cause of this crop failure. The local Agricultural Department, the Indian Central Cotton Committee, as well as the staff of B.C.G.A. (Punjab) Ltd., have given a good deal of their energies to this problem. The results have been published and very complete abstracts have

appeared in this journal. A review of the literature is therefore unnecessary. The problem is of undoubted importance. In a year of general crop failure the loss to the Province was in the neighbourhood of £5,000,000 before the great fall in prices took place.

During the years 1928-31 the writer came in close contact with this problem when he was called upon to advise the Bikaner Darbar on the cotton policy to be adopted on the new Gang Canal. As is well known, that portion of the Bikaner State which is included in the valley of the Indus and which consists of alluvial soil (intermediate in texture between that of the Canal Colonies of the Punjab and of Sind) has recently been commanded by irrigation water drawn from the Sutlej. A new Canal Colony has been created. As the area commanded is comparatively large while the amount of water available is somewhat restricted, it is important to stretch the supply to the uttermost and to raise the crops, including cotton, on the minimum number of waterings. In one respect this restricted water supply is a great advantage. It will discourage over-irrigation—a practice which on alluvial soils particularly always leads to the development of excessive quantities of alkali salts. This condition renders all crop-production either difficult or impossible.

The first step in the saving of irrigation water on the new Canal was to demonstrate to the Darbar and to the cultivators what can be accomplished with a small water supply. Accordingly a small experiment station was established at Ganganagar—the headquarters of the New Canal Colony. Very satisfactory crops of wheat and grain were raised on a single irrigation after sowing, instead of by the usual three waterings. Attention was then paid to monsoon crops, including cotton. The first point to decide was which type of cotton—American or indigenous—is most suited to these alluvial soils. Seed of these two types, which had given the best results at the B.C.G.A. Estate at Khanewal, was obtained from Mr. Roberts and grown for two seasons side by side on a large scale at Ganganagar under strictly comparable conditions. The results were decisive. The indigenous cotton proved to be the better in every respect except one—the length and quality of the fibre. The yield of seed cotton was much higher, the crop was healthier and more robust, while the stand was so vigorous that a very satisfactory ratoon crop was obtained after cutting back at the end of the cold weather. The American crop was also ratooned, but there were many blank spaces and the growth left a good deal to be desired as regards health, vigour and yield. Steps were then taken, with the help of a grant from the Indian Central Cotton Committee, to draw up a programme of cotton

improvement in which the isolation of an indigenous type with a much superior fibre, was included. At the same time the possibility of finding a suitable American type was not overlooked. While these preliminaries were being disposed of, the effect of thorough cultivation before sowing combined with the grading of the surface was demonstrated. The results far exceeded expectation. Yields of seed cotton in the neighbourhood of a ton to the acre were obtained with the indigenous variety—a result amply confirming the earlier experience on this subject obtained at Khanewal. These matters—thorough cultivation before sowing combined with the grading of the surface so that there is an even flow of irrigation water over the land without overwatering or local water-logging—are at least as important on the Gang Canal as the improvement of the variety.

During the course of this work a good deal of thought was naturally devoted to the Punjab cotton problem. The literature of the subject was carefully studied: the crop on the various types of soil met with in the new Colony was compared with the behaviour of the cotton plant on the black soils. These observations suggested that the Punjab cotton problem should be looked at from a new standpoint. The development of the root-system and the soil conditions should be considered together as one subject.

The general distribution of the root system of American cotton is well known. There is a marked tendency for the tap root to throw out strong laterals near to and roughly parallel with the surface of the soil. Most of the root-system is superficial. The plant is therefore dependent for a large portion of its water-supply on the upper layer of the soil. Much more detailed information is, however, urgently needed. Studies of actual root development throughout the whole life of the crop—from sowing time to the last picking—are required. The general facts of root-development must be supplemented by a complete knowledge of how the cotton plant makes use of the soil—of the actual zones where the root-hairs are active and from which the plant obtains its water supply. This can only be ascertained by very careful exposures of normally growing plants at suitable intervals —once a month till flowering begins and once a fortnight afterwards.

The study and record of the subterranean activities of the plant is only half the story. The soil solution must at the same time be examined. This must be carried out in those zones of the soil in which the root-hairs are active. The object is to obtain as complete a picture as possible of the soil solution which the cotton plant actually uses. This picture must then be studied in relation to the active root-system of the crop.

Now the above-ground behaviour of the cotton plant at flowering time in a year of crop failure suggests that the root-hairs are working in zones in which the soil solution contains a high proportion of alkali salts. This would prevent the root hairs from absorbing an adequate supply of water from the soil solution and would affect the transpiration current very much the same as an insufficient supply of soil-moisture. Such an interference is particularly dangerous at flowering time when the normal development of the anthers as well as of the seed is very easily upset. The anthers are perhaps the most sensitive portion of the floral mechanism. The presence of appreciable quantities of alkali salts in the soil solution after flowering begins would fully explain all the observed facts. These quantities need not be sufficient to interfere with the ordinary vegetative growth of the plant. All that is needed is sufficient alkali to hamper the water supply during the critical flowering period. Should these considerations be confirmed the failure of American cotton in the Punjab will form a part of the larger alkali problem.

At this point two questions suggest themselves. In the first place, what is the reason for the comparative immunity of the indigenous variety to this crop failure? In the second place, are there any facts which support the view that the soil solution is likely to contain harmful quantities of alkali salts?

The comparative immunity of indigenous cotton can be explained by the diffused nature of its root-system and by its relative independence of the upper soil layers for its moisture supply.

There is unfortunately a very strong body of evidence in favour of the view that alkali salts are concerned in this problem. Large tracts of barren alkali land are common on the alluvial soils of North-West India. Alkali patches in which the crops either fail to reach maturity or produce low yields are common all over the Canal colonies of the Punjab on which American cotton is grown. Small quantities of alkali salts are common on the banks of the water-courses and on the borders of fields. Without exception all the crops raised on these irrigated tracts ripen with great slowness. There is a large amount of evidence that the alkali condition is a direct consequence of poor soil aeration resulting from over-irrigation. This evidence was published in 1924 in *Crop-production in India*. If the chapter on the alkali problem in this book had to be rewritten today it would require practically no revision.

The object of this paper is to provoke and also to suggest that the Punjab cotton problem should be examined afresh. The root-system of the crop should be carefully considered in relation to the

soil solution and to the general alkali problem of the alluvial soils of North-West India. Provided an adequate range of knowledge can be brought to bear on this subject, and an investigation with the requisite degree of independence of thought can be set to work and also provided with necessary freedom and facilities, there seems little doubt that the results obtained would well repay the cost. They could not fail to throw light on the subject under discussion and also on the general problem of alkali land.

Received September, 1933.

THE BOLLWORMS OF COTTON

BY

C. B. WILLIAMS, Sc.D.

Chief Entomologist, Rothamsted Experimental Station.

Formerly Chief Entomologist to the Ministry of Agriculture of Egypt.

COTTON plants throughout the world are liable to severe injury by caterpillars of various species of moths eating the centre of the growing boll and so destroying, partly or completely, the production of lint from that boll. A number of species have been recorded with this habit, but four of them are of outstanding importance either from their wide distribution, the severity of damage, or from both these causes. These four insects which are discussed below are the Pink Bollworm, the Common or Spiny Bollworm, the Sudan or Red Bollworm, and the American Bollworm or Corn Ear Worm. The first three of these are practically confined to cotton, but the last has a large range of food plants of economic value, which has the double effect of making its control more difficult and its depredations more serious. The Pink Bollworm and the American Bollworm are almost worldwide in their distribution, the Spiny Bollworm is confined to Africa and Asia, while the Sudan Bollworm so far has not been recorded outside the African Continent.

The Pink Bollworm (*Platyedra gossypiella*) is the larva of a small moth, only about half an inch across the wings and brownish in colour, belonging to the family Tineidæ. It lays its eggs on cotton, or more rarely on related plants such as *Hibiscus cannabinus*, *H. esculentus* and *Althæa rosea* (Hollyhock). The pinkish larva is also small, only half an inch long when full fed, and is almost always found within the bolls, sometimes as many as a dozen in a single boll, and with no visible opening to the exterior to indicate its presence within. This differentiates it immediately from the other bollworms, which always make openings in the boll either for breathing or for the extrusion of excreta. The larva generally comes out of the boll when fully fed and pupates in a slight cocoon either in the ground, in a partly open boll, or in any convenient shelter either on or off the plant.

The insect first came to notice as a pest when specimens were sent home for identification from India, about ninety years ago, with the information that they were causing damage to cotton. By 1904 it was well known as a pest of cotton in German East Africa, and about

the same time it appeared in the Hawaiian Islands, but its first occurrence as a pest of major importance was in Egypt.

Its introduction into that country is a good example of the uselessness of half-measures in attempts to keep out insect pests by means of importation restrictions. For many years Egypt had had a law prohibiting the importation of cotton seed, but when a spinning factory near Alexandria imported bales of Indian cotton containing large numbers of cotton seeds, as an impurity owing to faulty ginning, it was not considered that the law could possibly apply to these seeds. There is no doubt that it was in these seeds that the Pink Bollworm was introduced into Egypt sometime between 1908 and 1910. In the latter year it was first discovered in the cotton fields, and two or three years later there was not a field of cotton in the country free from its attack. It is a conservative estimate that the Pink Bollworm has destroyed 10 to 15 per cent. of the Egyptian cotton crop in the last twenty years, thereby causing a loss of over one hundred million pounds.

In 1911 several tons of cotton seed were sent from Egypt to Mexico, and about the same time a large supply went to Brazil, with the result that both these countries became infested with the Pink Bollworm, and from them the insect has spread to the West Indies and to the cotton belt of the United States, in spite of all precautions taken to prevent it.

There is now scarcely a cotton-growing country in the whole world where the insect does not exist, as in addition to the countries mentioned above it is now known in West Africa, Australia, Korea, Siam, Sudan, Palestine, etc. Up till quite recently, however, the insect was not known in Iraq; some pink larvæ from cotton bolls in this country sent to us in Egypt for identification some years ago proved to be *Platyedra vilella*, a closely related species known to feed on pods of various species of *Malva* in Europe, North Africa and West Asia.

The insect owes its tremendous powers of distribution to two factors. First, that the moths have a relatively long adult life and are capable of flying or drifting many miles; I have captured moths in the Egyptian desert ten miles from the nearest cotton field. This accounts for their rapid local spread in a new district. And, secondly, that the caterpillars when full fed can, under certain not very well understood conditions, spin a light cocoon and within it go into a resting stage, before pupation, which may last from three to eighteen months. This resting stage is most commonly found towards the end of the cotton season, and the cocoon is usually spun

between two partly eaten cotton seeds which are held firmly together by the silken threads. In this state the larva is separated with the seed from the lint in the gins, is transported with the greatest of ease over long distances, and is planted in the field with the cotton seed under the most perfect conditions for its future existence. It was in this resting condition that the insect passed from Egypt to the American Continent, but large consignments of cotton seed are by no means the only source of danger, as more than a dozen moths once hatched out of a handful of cotton that we received in Egypt from India wrapped as a protection round a box of delicate specimens.

Under Egyptian conditions the seasonal history of the insect is as follows. Moths begin to appear in small numbers at the end of April and in May, but the main emergence is in June and July, when they find abundance of green bolls on which to lay their eggs. Several overlapping generations follow rapidly. By the end of July about 10 to 20 per cent. of all the green bolls in the fields of Lower Egypt already have larvæ in them. By the end of August the percentage has increased to anything from 30 to 70 per cent., and by the end of September it is practically impossible to find a green boll free from damage. The rise of infestation varies from year to year, and it has been found to be early in years in which the cotton is early and late when the cotton is late.

Up to about the end of August nearly all the larvæ pupate as soon as they are full fed, but from this time onward a gradually increasing proportion enter into the resting stage and lie over for a longer or shorter period as already explained.

The first picking of cotton in Egypt takes place about the middle of September, and in this the damage is usually slight. The second picking is in the second or third week in October, and damage is severe. A third picking was formerly taken later still, but the combined attack of Spiny Bollworm (*Earias*) and Pink Bollworm has made this impossible.

After long experiments no method has been found that is of any commercial value in destroying either the moths or larvæ in the field during the growing of the cotton; nor have parasites, either native or introduced, been successful. Energies have therefore been devoted chiefly to preventing the carry-over of the insect from one cotton-growing season to the next, and it is interesting to note how conflicting commercial interests and local conditions have complicated this problem.

Towards the end of the season the insect exists in large numbers in the following situations:

(1) As resting larvæ in the seeds in the picked cotton that has already been carried to the store or ginnery. Recent investigations show that for each acre of cotton about 150,000 worms are carried away in this state.

(2) As resting-stage larvæ and short-cycle larvæ and pupæ in the bolls still remaining on the plants. About 50,000 per acre is the estimate for this population.

(3) As larvæ or pupæ in the rubbish on the ground and buried under the surface. About 15,000 per acre are in these situations.

The larvæ in the picked cotton are dealt with very successfully by compulsory heating of all seed, immediately after ginning, to a temperature of about 60° C. (140° F.), which kills the worms without injuring the germination of the seed. To prevent a carry-over of the larvæ in unginned cotton there is a law stating that all cotton from the previous crop must be ginned by April 1. This sound rule, however, is not always enforced owing to the opposition of both ginners and growers, who often prefer to hold the cotton unginned awaiting a suitable market.

The control of the larvæ remaining on the plants in the field is greatly complicated in Egypt by the necessity of using the cotton sticks during the winter as domestic fuel, owing to the great shortage of any other material that can be used for this purpose. By law all cotton must be cut down to ground level by November 30. The plants are cut or pulled up and carried to the villages, where they are stored in great piles—usually on the flat roofs of the houses. Dead bolls containing larvæ are knocked off in the field or by the roadside, and millions of larvæ are carried to the roofs and are stored up under conditions ideal for their survival to the next season. In countries where this fuel shortage does not exist the remains of the crop are usually burnt in the field and the survival of the insect enormously reduced. It was at one time suggested that a law should be passed insisting that all cotton sticks kept for fuel should be burnt by April 1, but it was never proceeded with, owing to the impossibility of inspecting the roofs of hundreds of thousands of houses in thousands of villages, particularly in a Mohammedan country.

The larvæ and pupæ in the soil are impossible to deal with except by methods of general agriculture, and the most hopeful of these appears to be the growing of winter crops which require heavy watering.

Thus we see that the control of the Pink Bollworm in Egypt is made more difficult by two factors: (1) the development of the long cycle larva just at the time of the year when it is possible to establish a

close season; and (2) the fuel shortage, which makes it impossible to burn the crop residues in the field.

Investigations are now proceeding along a third line of attack, which is the production, by selection of seed, agricultural operations, watering, and distance of planting, etc., of an earlier cotton crop. This will enable the major portion of the cotton to be picked before the Pink Bollworm attack reaches its maximum, and will also enable the close season to be started earlier and so prevent the development of many of the long-cycle larvæ.

It is a remarkable fact that in several other countries where the Pink Bollworm is found, for example in Madras and the West Indies, the long-cycle larva is rare or absent. Under these circumstances a close season has a very much greater effect as a control measure. This condition is possibly connected with the absence of any definite cool or dry period in the climate cycle.

In the Sudan, where the insect was introduced about 1912, the seeds when laid out in thin layers in the sun reach a temperature sufficiently high to destroy the worms, and so the high expense of machinery treatment is avoided. On the whole, the insect has caused little damage in this country, except in the Gezira in some years when there was a heavy carry-over of seed cotton from one year to the next owing to commercial reasons.

In the cotton belt of the United States there have been several localized outbreaks of Pink Bollworm. Some of these, for example in East Texas and South-West Louisiana have been completely exterminated, but the insect still has a firm hold in parts of Arizona, New Mexico and West Texas. In June of last year (1932) a new infestation was discovered in Florida, especially in a wild cotton which grew luxuriantly along the shore line in the Keys of the southern part of the State, but later in the year it was also discovered in the cotton area in the northern portion of the same State.

The Pink Bollworm owes its position as the major pest of cotton to its wide distribution, to the enormous numbers which exist in the infected cotton fields, and to the way in which the larvæ are completely hidden in the boll without any external sign of injury until they emerge or the boll dries up and opens.

A closely related insect, *Platyedra scutigera*—for a long time confused with the Pink Bollworm—does almost exactly similar injury to cotton in Queensland. The loss, however, is slight except where the cotton is ratooned.

Long before the outbreak of the Pink Bollworm in Egypt the cotton of that country suffered from the attack of another bollworm,

the Common or Spiny Bollworm, which is the larva of a greenish moth (*Earias insulana*) about one inch across the wings, and belonging to the family Noctuidæ. The larvæ are dark green in colour and covered with short stout spines which make them immediately distinguishable from any of the other bollworms. When they attack a boll they leave a hole in the exterior through which excreta are passed out. They also may move from one boll to another in the course of their larval life. This insect has no long resting stage, and the early laws in Egypt establishing a winter close season and forbidding the ratooning of cotton were directed against it with considerable effect.

The Spiny Bollworm also has a very wide distribution, being found in almost all the cotton-growing areas of Africa and Asia, but it has not yet reached the American Continent. For a long time it was confused with several related species, and even now its identification is not an easy matter except for a specialist. The adult moth is very variable in colour: sometimes all green on the four wings; sometimes green with brown markings, and sometimes a drab yellow without any green. Storey in Egypt showed that these were seasonal forms of the same insect, though most of them had been given specific names. The insect feeds on several plants related to cotton, such as *Hibiscus esculentus* and *H. cannabinus*, *Malva parviflora* and Hollyhock (*Althæa*). In Punjab some success has been achieved in the control of the pest by using *H. esculentus* as a trap crop, and ratoon cotton has also been used in the same way.

The insect has no long resting stage in which transport from one country to another would be possible, and its powers of flight seem to be limited, although on one occasion I found the moths in numbers settled on various small bushes in the desert near Cairo, about eight or ten miles from the nearest cotton. Although I visited this spot many times I never saw the bollworms there again.

The Sudan or Red Bollworm (*Diparopsis castanea*) is a pest of more limited distribution than either of the two insects so far considered. It is found in most of the cotton-growing districts of Africa south of the desert belt, but is not known in Egypt, nor in any other continent. The moth is a larger insect, about one and a half inches across the wings, with banded wings of very variable colour: green, yellow or reddish brown. It also belongs to the family of the Noctuidæ.

The insect was first observed in the Sudan about 1906, but was not considered as a pest until at least ten years later. The life history is comparatively simple. The eggs are laid singly on almost any part of the cotton plant and the larvæ kill flowers and young bolls. In the boll they eat out the centre portion, always leaving an opening to the

exterior. The larvæ when full grown are green with reddish markings, the red slightly resembling that of the pink bollworm, but in size they are well over an inch in length and so about twice as long as the latter. Pupation takes place in the ground.

No other food but cotton has been recorded in the Sudan, but in South Africa *Hibiscus calycinus* and another malvaceous plant are considered as rare alternative host plants.

It is remarkable that when the insect was first discovered in the Sudan, it was found to be single brooded, and it was also still single brooded in the Nuba Mountain Province in 1926, when cotton was a recent introduction there. But in the Shendi district and at Zeidab it is now continuously brooded and four or five generations follow one another in rapid succession during the cotton season. This change of habit has naturally caused it to be a very much more serious problem than before. The first adults appear about July, and after January the attack dies away owing to the pupal stage being prolonged.

No good control measures are known. Parasites seem to be of little value; agricultural methods directed against the pupæ in the ground and during the close season have not met with success. Large numbers of the moths have been captured in light traps, but the majority of these are males and many of the females have already laid their eggs.

Since the pest was first discovered in Sudan it has been found in South Africa, Rhodesia, Portuguese East Africa, Nyasaland, Somaliland, and French West Africa, but which of these is its original home and how it has been transported over such a large area is not known.

The American Bollworm (*Heliothis obsoleta*) introduces two new problems into the bollworm complex. It is an insect with a great range of food plants and in the adult stage it is capable of powerful and extended migratory flight.

The moth, with brownish fore wings and lighter hind wings with a darker edging, is about the same size as that of the Sudan Bollworm, and belongs to the same family of Noctuidæ. It is found in almost every country of the world, including the United States, the West Indies, South America, Africa, Australia, Korea and Hawaii. In the course of its wanderings it even reaches the British shores, where, as a curiosity prized by local entomologists, it passes under the name of " The Scarce Bordered Straw."

It is a major pest in different parts of the world of cotton, maize, tomatoes, tobacco, lucerne and many other plants, so that control measures based on a close season for a single crop are of no value. In

the United States the annual damage to cotton alone has been estimated at over eight million dollars, most of which is in the Central and Western portions of the cotton belt. The caterpillars bore into the cobs of corn or the bolls of cotton. Young bolls are completely destroyed and older ones gnawed into, but bolls which have already become hard are seldom touched.

In the United States the winter is passed in the pupal stage and moths emerge in the spring. The first two generations feed chiefly on maize, but by the third generation the corn has begun to harden and the insects turn their attention to cotton, and later still to alfalfa. Four or even five generations may be passed through before autumn comes.

In Queensland much the same thing occurs; the maximum attack on cotton develops in January and February and is most severe in cotton which has been planted late, particularly on rich loamy soils. On heavy clay soils the plants grow more slowly and appear to be less attractive.

In South Africa about four generations a year are found, and in the warmer portions of the country such as North-East Transvaal there is no resting period.

The migrations of this insect, to which reference has been made, are very little understood. In North America it is considered that the insect does not survive the winter in any stage north of Southern Pennsylvania and the Ohio River, yet in some years it becomes suddenly abundant even in Southern Canada. Similar migrations occur on an even larger scale in the American Cotton Worm (*Alabama argillacea*), but this insect confines its attention to the leaves of the cotton plant. In Australia also reference has been made to mass movements of the *Heliothis* bollworm, but care has to be taken to distinguish between immigration and sudden emergences from overlooked pupæ.

Control of this insect is along various lines. Dusting with calcium arsenate is practicable in many cases owing to the considerable amount of external feeding done by the larvæ. Winter ploughing, in countries where there is a winter, exposes the pupæ to the rigours of the climate and to birds and other enemies. In some countries it has been found possible to use rows of maize as a trap crop to attract the insects from cotton, but the maize must be in its most attractive stage before the cotton and must not be allowed to ripen or it will only act as a breeding ground.

The four bollworms of cotton discussed above are an excellent example of the fact that there is no golden rule for the control of insect

pests, even for those of quite similar feeding habits. Every detail of their life history must first be studied, and this must be taken into consideration along with the climate, geology, agriculture, geographical position, social conditions, state of education, and even in some cases the religion of the country, before advice can be given as to the best methods of control.

Received August, 1933.

GOOD PICKING

BY

F. R. PARNELL,

Plant Breeding Station, Barberton, Transvaal.

COTTON picking is easy work that can be carried out, after a fashion, by any style of native labour, young or old. There is a vast difference, however, in general efficiency, including cleanliness and quantity of seed-cotton picked, between good and bad pickers. There is a definite tendency for experienced growers, where they have the choice, to employ smaller gangs of good pickers in preference to large mixed gangs of very varying efficiency.

The smaller the gang the more easily it is controlled, the more uniform will the pickings be as regards cleanliness, and the less labour will be entailed in the weighing-in and inspection of individual pickings. Moreover, a gang of good pickers is more economical, even if they are paid by results, since they require less food than a larger gang of poor pickers giving the same output.

Different growers adopt different methods of encouraging efficiency. Prizes for the largest pickings are sometimes given, occasionally with a booby prize of a cake of cow-dung for the lowest. This is not a good scheme, as only a few of the best are encouraged eventually, and the worst may be triers who are not physically designed as cotton pickers. A better scheme is a bonus, in addition to a daily wage, for anything above a certain amount picked. This standard amount can be varied according to the condition of the crop and the amount of the daily wage. It comes to much the same thing as paying by contract on the amount picked, a common practice in the Barberton area. In this district the usual rate is 3d. for 10 lbs. of seed-cotton, either for a bonus or for contract work.

The condition of the crop makes a big difference to the ease of picking. Small compact plants carrying a good crop are much more easily picked than woody or straggling plants with less crop for their size. Rain on an open crop makes it less easy afterwards, as also does a wind storm that has blown the cotton about and messed it up with dead leaves. The amount of staining, if any, and the degree of cleanliness insisted on, are also important factors in determining the output.

Taking an ordinary crop of U. 4 in this area, and assuming the picking to be fairly clean, it is possible to give a rough idea of what

may be expected. A gang of native women on daily wages, chattering a lot and taking things easily, will pick about 40 lbs. a-piece of seed-cotton in a day's work. If they are paid by results there will be a little less chatter, rather more steady work and an average picking of about 50 to 60 lbs. Native men (" boys ") are much the same: some growers prefer them to women, others the reverse. On the whole, however, good boys are better than good women.

By paying pickers individually, on piece-work, it is possible to weed out the bad ones and raise the standard considerably. In this way as much as 80 lbs. can be got from a really good gang of experienced pickers. At the usual rate of 3d. for 10 lbs. this amounts to 2s. per day, a very high wage for these parts.

Individual pickers can do a good deal more than this and by selecting a few of the best, instead of weeding out only the worst, very high figures can be obtained. It is mainly with the object of recording some outstanding results in this direction that this article is written.

I am indebted to Col. G. M. Bennett, a cotton-grower of the Barberton District, for the figures given below. Col. Bennett, for some years, has been weeding out poor pickers and selecting good ones, and his average figure has been steadily mounting. His results for the 1931–32 season, when he employed only a few selected pickers, were exceptionally good. He writes: " Herewith statistics of my cotton picking for last season. Owing to the fact that drought conditions had curtailed my farming operations I had reduced my labour complement to the minimum possible and was faced with the problem of how to pick my small crop of cotton, 64 acres, most economically. I came to the conclusion that I would try to utilize the minimum number of my best boys for the job and employ them as and when required on the usual contract basis of 3d. per 10 lbs. of cotton picked. Each picker is given a picking sack and 2 muid sacks. They start when they like, generally sun-up, and finish when they like, generally about 4.30 p.m. Their food is brought to them and the cotton collected from them each evening. Each sack bears their ticket. The only check I have on their picking is an examination of the cotton when turned out of the sacks for baling. The five boys employed last season are old hands and always capable of producing their 100 lbs. per diem when the going is favourable. I was very lucky in obtaining Worrall's best boy, Piccanin, whom I employed for cotton picking only. My average yield was 628 lbs. per acre as the plants (U. 4) were small owing to conditions prevailing during the season. The smallness of the plants materially assisted

DAILY PICKING RECORDS OF INDIVIDUAL BOYS.

	Lbs. Seed-Cotton Picked per Day.				
	Solomon.	*Tanjane.*	*Jacob.*	*Mandinda.*	*Piccanin.*
April 1	161	126	145	146	
„ * 4	145	90	88	112	
„ 5	173	155	150	169	
„ 6	168	139	147	173	Not
„ 7	179	151	141	173	employed
„ 8	164	112	123	141	
„ *11	178	91	88	106	
„ 12	176	159	159	180	
„ 13	179	165	156	191	160
„ 14	185	148	149	179	162
„ 15	171	162	158	168	173
„ *18	178	78	120	161	152
„ 19	171	161	141		154
„ 20	174	155	156		163
„ 21	162	126	140		143
„ *25	118	92	—		105
„ 26	112	92	80		101
„ 27	122	94	85	Away ill	107
„ 28	137	133	130		134
„ 29	166	147	144		166
May * 2	137	88	—		115
„ 3	144	84	—		122
„ 6	162	145	154		145
„ * 9	161	84	81	90	103
„ 10	173	157	152	158	153
„ 11	171	167	138	163	168
„ 12	177	162	150	174	169
„ 13	189	165	157	181	187
„ *16	186	84	87	173	139
„ 18	183	176	139	182	167
„ 19	160	130	99	154	139
„ 20	179	148	122	165	161
„ *23	144	82	79	—	90
„ 24	176	158	155	—	188
„ 25	165	160	—	155	168
„ 26	169	163	—	178	166
„ 27	170	127	111	163	154
Totals ...	6,065	4,856	4,124	3,835	4,254
Days	37	37	32	24	29
Mean, to nearest lb.	164	131	129	160	147

Grand total ... ... 23,134 lbs.
Boy-days ... ... 159 „
Lbs. per boy-day ... ... 145·5 „

* Mondays.

my pickers as they always prefer to pick across the rows, each picker taking about 5 plants at a time in each row."

The boys did not clean up as they went but left badly opened cotton, together with points of locs that did not come away freely, for a final clean-up. They spent most of their time from the last few days of March to the end of June picking the good cotton. This amounted to over 90 per cent. of the total crop, the last clean-up of less than 10 per cent. being picked by women.

The table on page 284 gives the amount picked by each boy for every day on which he worked during April and May. The full details are given in order to show that it was a sustained effort and not a few freak pickings on good days.

The daily pickings are extremely good and far in advance of anything previously reported in this part of the world. It will be seen that the best boy, Solomon, brought in an average picking, for thirty-seven days, of no less than 164 lbs. of seed-cotton, whilst the average for the five boys over the whole period amounted to 145·5 lbs.

The figures are taken directly from Col. Bennett's picking book, a book that has been a source of interest, not unmixed with amazement, to the author for some years. The weights are actually slightly lower than they should be, presumably because the tare allowed for the bags in weighing-in is a little too high. This is shown by the fact that the ginnery weights for cotton sent in show about 3 per cent. more than the picking weights.

It will be noticed that Mondays are marked with an asterisk on the above table. A point of interest that emerges is the effect of the week-end on different boys. The "Monday morning feeling" has made quite a difference to the pickings. This is particularly the case with Tanjane, who averages 86 lbs. for Mondays against 144 for other days, and Jacob with 90 lbs. against 138. Both these boys are recognized beer-drinkers and spend their week-ends in a state of happiness. Their pickings for Mondays are good, as judged by ordinary standards, but they are obviously unable to rise to the normal very high standard when feeling a little off colour. The position is different with Solomon, who is not a regular beer-drinker, and he shows an average of 156 lbs. for Mondays against 166 for other days.

It may be mentioned that 20 per cent. of the crop graded *Strict Middling* and 70 per cent. *Middling*, which compares quite well with the general crop in the district, thus showing that the cotton was picked reasonably clean. All the early pickings were *Good Colour*, only the latest, about 12 per cent., being *Yellow Spot*.

Received September, 1933.

OVERSEA MECHANICAL TRANSPORT

BY

J. C. MAY.

THE Empire Cotton Growing Corporation realized from the commencement of their work that large tracts of country in different parts of the Empire were, so far, prevented from growing crops for export through lack of transport. It was also obvious that production in various areas growing cotton could be increased if transport costs were reduced. After preliminary enquiries, therefore, the Executive Committee appointed in March, 1924, a Sub-Committee to investigate and report on the best and cheapest form of mechanical transport, other than railways, for carrying cotton and its rotational crops.

The work of the Sub-Committee was described in an article which appeared in Vol. IV. No. 4 of the EMPIRE COTTON GROWING REVIEW. In short, the Committee recorded that, in their opinion, while a railway constitutes the best and cheapest form of transport, provided that it has enough to carry, it only permits of development on a substantial scale in a strip of country about fifty miles wide on each side of the line. They also found that the types of motor lorry then in existence could not carry produce at much less than 1s. 6d. a ton-mile, if proper provision were made for depreciation. It followed, therefore, that only highly priced commodities could stand a long haul by road, and the conclusion was reached that the first essential was a " main feeder " to drain effectively the inter-railway area, and to fill the gap between the costs of road and of rail transport.

It is obvious that roads constructed and maintained as in highly civilized countries are out of the question in areas still awaiting development. Further, the main feeder must be capable of hauling heavy loads in order to reduce costs per ton-mile to a figure that the traffic will bear. The problem, therefore, becomes one of producing some means of transport that will require neither a high-class road nor necessitate heavy expenditure upon the maintenance of cheaply constructed roads. At the time when the Corporation's Sub-Committee commenced work the pneumatic tyre had by no means reached its present stage of development. The standard tyre equipment of lorries was the high pressure tyre inflated to a pressure of about 90 lb. per square inch. The Committee thus were of opinion that

the first line of attack should be through the medium of " tracked " or " semi-tracked " machines. The difficulties of steering a vehicle running only on caterpillar tracks without damaging the road surface led the Committee to investigate the possibilities of utilizing tracks for carrying the load, thus minimizing the pressure per square inch on the road, and of using wheels for steering. Two half-track 80-cwt. lorries were accordingly secured, one fitted with hinged metal tracks and the other with Kégresse rubber tracks. Later a 2½-ton lorry with metal tracks was acquired, improvements having been made to the tracks and track mechanism as a result of the trials carried out with the smaller vehicle.

After trials in England under the immediate supervision of the War Department—who kindly allowed the tests to be carried out over gravel and earth roads that closely resembled conditions encountered oversea—the vehicles were shipped to Nigeria. There they were tested in the service of the motor transport department of the Nigerian Railways. The Sub-Committee found that these tests showed that an ordinary 2½-ton chassis fitted with a half-track and drawing a trailer would haul a load of 5 tons at a speed of 15 miles an hour on earth roads and would improve the road surface. These trials also showed, however, that tracks and track mechanism required many improvements, and that they were expensive both in first cost and in maintenance.

The Committee also carefully considered the question of fuels capable of being used as substitutes for petrol.

The compression ignition engine was at that time in its early stages as far as road transport was concerned, and the Committee decided to see whether a producer gas unit existed, or could be evolved, capable of giving satisfactory results in the hands of an African driver. A 2½-ton six-wheeled lorry was accordingly purchased in partnership with the Nigerian Government, and fitted with a Tulloch-Reading producer plant. The engine was modified in order to reduce as far as possible the falling-off in power that takes place when an ordinary petrol engine is driven on producer gas. The vehicle ran well during the trials in England, when it received very careful attention, often at the hands of the inventor. It did not, however, give satisfactory results in Nigeria, and the engine was reconverted to use petrol.

It is disappointing that, although large stationary producer gas plants are most satisfactory, small units on motor vehicles have not proved a success—and there have been numerous trials in different parts of the world—since many of the backward areas that could

be developed if cheap transport were available have ample supplies of wood from which charcoal could be made cheaply. Even if producer gas units for vehicles should ever prove reliable, they would always have one serious drawback: the plant and fuel are heavy and bulky, with the result that only a reduced useful load can be carried.

In 1927, after the Corporation had expended some £12,000 on the investigations and experiments carried out by their Transport Sub-Committee, they came to the conclusion that the whole question was too large, and the issues at stake too important, to warrant their continuing the work alone. The matter was discussed at the Colonial Office Conference held in that year, and it was agreed that it was essential that some organization should be set up to investigate, and if possible improve, new forms of mechanical transport with a view to their adaptation to the requirements of undeveloped territories. The Empire Marketing Board were asked to consider the question of finance, and a Conference summoned by them found that experimental work such as that suggested could appropriately be supported by the Board, since, if successful, it would make it economically possible to market in this country many products which hitherto it had not been possible to market here at all.

The matter was finally referred to a Sub-Committee of the Committee of Civil Research, and on their recommendation the Oversea Mechanical Transport Directing Committee were appointed by Mr. Amery, at that time Secretary of State for both the Dominions and the Colonies. Sir James Currie undertook to serve as Chairman of the Committee, and the Corporation provided them with office accommodation. The Corporation have thus been intimately connected with this work since its inception.

The Empire Marketing Board generously offered to finance the first year's expenditure, and made it possible to start work at the end of 1928. Arrangements were also made in due course whereby twenty-three of the Dominion and Colonial Governments agreed to contribute towards the cost involved, and the Overseas Mechanical Transport Council were constituted, consisting of representatives of the contributing Governments and of the Empire Marketing Board. The Directing Committee continued to be in charge of the experimental work, and reported progress periodically to the Council.

The problem before the Committee has already been outlined—namely, the provision of a means for reducing road transport costs by hauling heavy loads over cheaply constructed roads, involving at the same time the minimum expenditure on road maintenance.

Bearing in mind the experiments carried out by the Corporation's

Sub-Committee, and the advances made by the War Department in the construction of tracked fighting machines, the Directing Committee entrusted two well-known firms with the task of drawing out a design for a unit consisting of a tractor and two trailers, all mounted on caterpillar tracks. One of these firms manufactures agricultural tractors and machinery, and the other builds vehicles for the War Department. It was decided that, to commence with, the unit should be capable of handling a useful load of forty tons. As the design work proceeded it was found that it would not be possible for the vehicles to maintain an average speed of more than five miles an hour if the cost of track maintenance were to be kept down to an economic figure. This meant that the output in ton-miles per hour would be low, and this consideration, added to the question of the cost of constructing the large tracks and track mechanism required, together with the difficulties in handling the tracks when under repair, forced the Committee to the conclusion that such a unit would not secure the reduction in haulage costs for which they were seeking. The scheme was accordingly suspended in its comparatively early stages.

At this time rapid strides were being made by tyre manufacturers in the development of large section low pressure tyres. The Committee therefore set to work, in conjunction with Messrs. Leyland Motors, Ltd., to draw out a design for an 8-wheeled tractor, and co-operated with another Lancashire firm, Messrs. R. A. Dyson of Liverpool, in designing the trailers necessary to spread the load over a number of axles, and so keep down the pressure on the road surface.

The resulting vehicles have proved highly successful. After testing this unit of a tractor and two trailers for 5,000 miles in England over soft earth and gravel tracks on War Department land near Aldershot, it was sent to the Gold Coast in February, 1933. The unit which carries a useful load of 15 tons, has now covered 6,000 miles in the Colony, chiefly on the 250-mile run between Kumasi in Ashanti and Tamale in the Northern Territories. Owing to the slump in the prices of all raw materials, and the fact that it has been the "slack transport season," it has been difficult to secure full loads for the unit up to the present. In spite of the fact, however, that the load carried has so far only averaged ten tons, it has been shown that the unit can in slack season conditions carry produce at a cost of somewhat under 5½d. per ton-mile, after making generous provision for interest, depreciation, maintenance, and supervision.

The lessons learnt during the tests of the first unit have been applied in the building of a second, which has proved to be superior

to its forerunner in a number of directions. The first tractor was fitted with a petrol engine to avoid combining too many experimental features in one vehicle; the second, which has been built for the Committee by the Associated Equipment Company, is equipped with a heavy oil engine of the type that has been well tested in the London omnibuses. This results in a very considerable saving in fuel costs. The average price that has been paid for petrol for the first unit at Kumasi has been 2s. 3d. a gallon; suitable heavy oil can be purchased there for 8d. a gallon. In addition, the compression ignition engine is thermodynamically considerably more efficient than the petrol engine, and thus gives a larger mileage per gallon; also, heavy oil does not evaporate as is the case with petrol—especially in the tropics—and the danger from fire is greatly reduced.

It was felt, when designing the first tractor, that it would be advisable not only to drive, but also to steer by means of all eight wheels. In the second tractor it has been found quite satisfactory to arrange the steering on the first and last pairs of wheels, thus effecting a saving in cost and a simplification in the steering lay-out. All eight wheels are driven, however, in order to secure the adhesion necessary for hauling the two trailers.

A general idea of the scheme can be gathered from the accompanying illustrations of the second unit. (Both units have consisted of a tractor and two trailers, all three vehicles having eight wheels.) The tractor carries 3 tons and the trailers 6 tons each, making a total useful load of 15 tons. By spreading the weight in this way no laden axle weight exceeds 3 tons and is therefore no greater than that of the ordinary 30-cwt. lorry. All the wheels are fitted with low-pressure pneumatic tyres, 10½ inches in section, with the result that the pressure per square inch imposed on the road surface is less than that due to a 30-cwt. lorry. In addition, all the wheels are articulated, which reduces road shocks and minimizes wear of both road and vehicle. The trailers are each carried on two 4-wheeled bogies and are automatically steered by the drawgear, so that they follow accurately in the tracks of the tractor, and do not " cut in " as does the ordinary trailer. This is of considerable advantage when traversing difficult country or rounding sharp turns, as the driver is able to concentrate his attention on the road ahead instead of having to concern himself as to whether an obstacle that he has only just cleared with the tractor wheels will be struck by the trailers. This " true tracking " also enables the unit to be backed for some little distance. The trailers are entirely free from the common fault of " weaving "—that is, swaying from side to side—at anything like

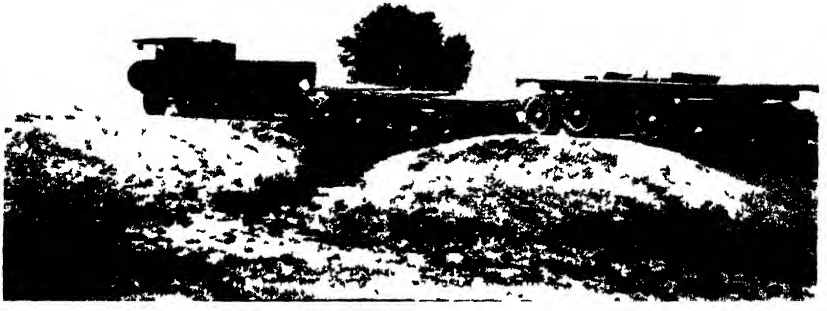


Fig. 1. — Driving Along a Rough Track

Fig. 2. — The Articulation of the Wheels Ensures Good Adhesion and Reduces Road Shocks

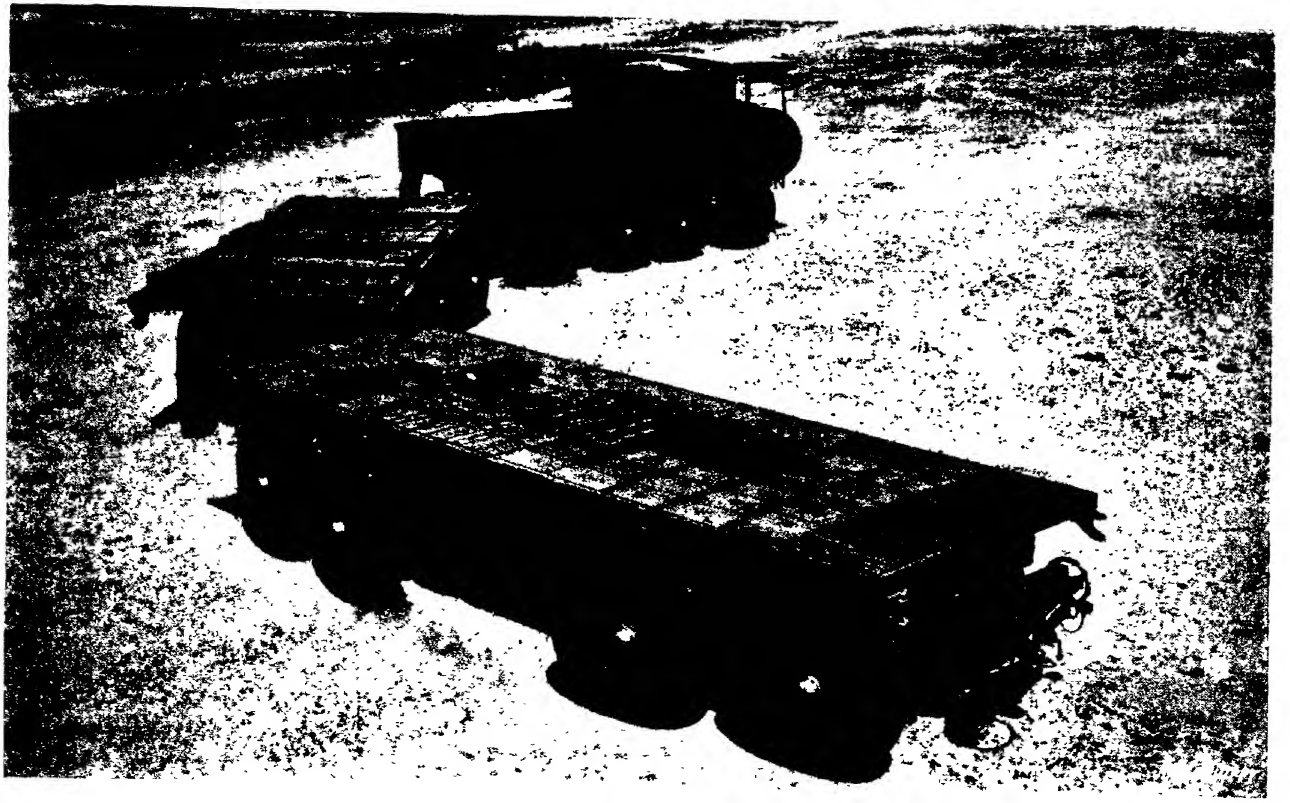


FIG. 3. THE UNIT TURNING.

a moderately high speed. Special attention has been paid to the braking system, the vehicles being fitted with Westinghouse brakes which are so arranged that the travel of the foot-brake pedal first applies the brakes on the rear trailer. Further pressure applies the brakes on the front trailer, and finally those on the tractor. This removes the risk of the tractor being pushed round by the trailers on a bend when descending a hill. It may also be mentioned that the trailers can be coupled up at either end to suit the driver's convenience, and when uncoupled, if it is necessary to manœuvre them in a constricted space, they can be steered by means of a steering pole.

The tractor, as before mentioned, is fitted with a heavy oil engine; this is of the A.E.C. compression ignition type, having six cylinders and giving 128 brake horse-power at 2,000 r.p.m. As many standard A.E.C. components as possible have been incorporated in the chassis in order to minimize first cost and expenditure on maintenance. The radiator has been mounted behind the driver's seat; in this position it is less liable to accidental damage, and should be out of reach of dust and of grass seeds, which tend to block up the radiators of vehicles running in areas where tall grass grows right up to the edge of the road. The radiator fan draws a current of air past the driver and thus keeps the cab cool. The water in the cooling system cannot reach boiling-point even in the highest atmospheric temperature to be met with in the tropics. When laden with its load of 8 tons the tractor weighs 11 tons 15 cwt., while each trailer laden with 6 tons weighs just under 10 tons. The unit carrying 15 tons will climb a gradient of 1 in 6½, while the tractor alone loaded with 8 tons will climb a slope of 1 in 2½. The trailers are, however, capable of carrying 8 tons each, so that in country with very steep gradients or heavy going the tractor and one trailer could haul a useful load of 11 tons. The three vehicles together can cross a long span bridge built to the heavy loading specification of the Crown Agents for the Colonies, and can turn round without reversing in the same space as that required by a 2½-ton lorry.

The second unit has now covered 1,500 miles in England, and it is expected that the vehicles will shortly be shipped to Australia to undergo further trials on commercial transport routes in the Commonwealth.

It is hoped that such motor transport units will do much towards reducing the cost of road haulage, and will assist the railways oversea by adding to the volume of produce that can be exported in these times of low prices. The Directing Committee are convinced, however, that these vehicles are but the first step towards the object aimed at, namely, the production of a unit capable of handling about twice

the load of the present unit, yet without imposing too high a pressure on earth roads that have a surfacing of gravel.

The major problem at the moment, however, is one of finance, as the Empire Marketing Board cease to exist on the day on which this article will appear in print. The majority of the oversea branch railways do not pay their way even after they have been given full credit for the traffic they bring to the main line. The production of a satisfactory 30-ton road transport unit would render it unnecessary ever again to build a branch railway until some new area that had been developed by this means was producing such a quantity of goods that road transport was no longer capable of handling the traffic involved. Should such a position arise, a railway could then be built with the knowledge that it would be a paying proposition from the day it was opened to traffic.

On the other hand, if an area should not fulfil its early promise, motor transport vehicles can be removed cheaply and expeditiously and used elsewhere. A railway that cannot pay its way is an almost total loss. Railways have to be built to a costly minimum standard, whereas a road can be developed gradually as the traffic demands. The relative figures in a country not requiring a large amount of bridging are roughly £250 a mile for a road that would carry the units that the Directing Committee have in mind, and £5,000 a mile as the minimum for a railway.

The Directing Committee have attempted to assist those engaged upon duties in connection with motor transport and public works in a number of directions in addition to their heavy transport work. The publication of the *Oversea Mechanical Transport Bulletin* was commenced in October 1929; it has appeared quarterly ever since. Each issue contains, in addition to original articles on motor transport and road and bridge work, abstracts from a wide range of periodicals published in various countries, dealing both with the construction and maintenance of the lighter and therefore cheaper types of roads, and with developments in vehicles and their accessories which appear suited to oversea conditions. In this way the Committee have sought, not only to summarize all the latest information to be obtained on these subjects, but also to link up the road with the vehicle and to secure some co-ordination between the road builder and the road user. Further, whereas the average publication that includes abstracts from current literature gives bare summaries only of the information contained in the original articles, an attempt is made in the *Bulletin* to include in a concentrated form all the essential details contained in the original. The great majority of the readers of the *Bulletin* have no library to which they can refer, or from which

they can obtain periodicals containing articles which seem likely to be worth reading in connection with their work. It is gratifying to be able to record that appreciations of the *Bulletin* have been received from many oversea officers.

In view of the very large number of 30-cwt. lorries used throughout the Empire, and the troubles that have been experienced as regards cooling and travelling over soft ground, the Directing Committee have looked into the possibilities of improving performance in these directions. A special radiator has been so designed as to fit on to the standard lorry with the minimum of alterations, and has given very good results. A special tyre for soft sand has also been devised, and as a result of tests carried out abroad the War Department have decided to equip a number of vehicles for service in Egypt with this type of tyre.

In the hope that it might be of assistance to oversea officers when considering the question of ordering new vehicles for their Departments, the Directing Committee have carried out tests of new vehicles that seemed to possess features calculated to render them specially suited for Dominion and Colonial use. The tests are carried out over the same course in each case, and notes are included in the reports as to the state of the roads and the weather at the time when the tests are conducted. In this way an approximate comparison can be made by the recipients of the reports between the performances of the various vehicles tested. The course was chosen over ground that approximates as nearly as possible to a variety of conditions that are commonly encountered oversea.

The Committee have also given considerable thought to the question of the minimum standard to which highway bridges should be built, in order to provide an adequate margin of safety for future motor vehicle and road development. It is obviously false economy to build bridges that are at all likely to prove inadequate some time before the end of their economic life, yet this is a temptation when funds never fully meet all the work that appears essential.

Enormous strides have been made in motor vehicles during the last few years, and much has been learnt regarding the construction and maintenance of cheap roads. The co-ordination of road and rail transport requires the most careful thought in all the Dominions and Colonies, as otherwise things may drift into the position in which Great Britain finds herself today. It is impossible to strangle development even by legislation, and it is essential that road and rail transport be each allotted its proper and economic sphere so that the one may assist the other, and that wasteful competition may be avoided.

Received September, 1933.

COMPARATIVE COTTON PRICES, 1932-33

BY

JOHN A. TODD, M.A., B.L.

THERE have been three main features of the movement of prices during the past season. In the first place we have no new low records to report, which is something of a relief after the experience of the previous three seasons.

The season opened with a sharp rise in the prices of commodities in general as the result of the wave of optimism which followed the Lausanne Agreement, and in the case of cotton this was accentuated by the very small crop figure shown by the first Bureau report on August 8. But neither of these proved lasting. The general rise of prices came to an end early in September, and it is perhaps not too much to say that cotton led the decline, for the September report failed to confirm the expected further reduction of the American crop figure, and with the October report the Bureau estimates began to rise, and finally touched 13,000,000 bales as against the August estimate of only 11,306,000 bales.

The general decline continued until the first week of March, 1933, when the whole situation was again changed by the American banking crisis, which finally resulted in America deliberately going off the gold standard and adopting a policy of definite inflation. In the new rise of general prices which resulted cotton prices in America had their full share, but Liverpool and other markets did not fully reflect the rise in New York and New Orleans. The extent of the inflationary tendency in America may be gauged by the fact that the sterling-dollar rate of exchange, which in November, 1932, touched $3.14, actually went above par to $4.87½ on July 19, 1933, but from this there was again a sharp reaction to below $4.50.

The result is that there is now practically no gold price for cotton in the world, for America was the only major cotton-producing country in the world which was still on the gold standard a year ago, and this makes it extremely difficult to compare prices today with prices of former years when most of the cotton-producing countries were on the gold standard. Subject to this it may be noted that on July 18 in New York May futures touched 12·50 cents, which is the highest price recorded since August, 1930, but this was followed by

a severe shake out which within three days brought near month futures below 10 cents again.

But as the prime cause of the major movements in cotton prices in the last two years was the August Bureau report, which in 1931 caused a serious fall and in 1932 a sharp rise, so in 1933 we have again to record that the publication on August 8 of a crop estimate much larger than the market expected produced a further decline which brought prices below the 9 cents level. This, however, was a long way above the low point of the season, which was 5·38 cents for the near month on December 8. In Liverpool the low point was in the first week of the season (4·39d. on August 3).

Turning now to the relative prices of different kinds of cotton, as will be seen from Table II. the premiums of Egyptian cotton over American have fluctuated very considerably and there is a marked difference between the general trend of the Sakel and Uppers premiums. On the whole Egyptian cotton has throughout refused to follow the extreme movements of American. Thus when American shot up in August, 1932, Egyptian lagged behind, but when American came down again in September Egyptian had less to lose. Again when American was at its lowest, round the new year, Egyptian held its ground, but lost again relatively in the latter months of the season when the American inflation began. On the whole, however, the range of the Sakel premiums during the season 1932-33 has been definitely lower than it was in the previous three seasons. The Uppers position, however, has been rather different. During the season the premium touched a point as high as anything in the previous three seasons, though that was not maintained during the later months of the season, partly as the result of the growing prospects of a very large increase in the Uppers crop in the coming season.

Table III. gives the relative spot prices of other varieties, and it is noticeable that during the past season there has been a return to the normal grouping of these varieties; with Uppers, Tanguis and East African in one group, Peruvian, West African, American and South African in another, and Indian definitely lower. In the first group there has been a marked appreciation of Tanguis against both Uppers and East African, and at the end of June Tanguis was again above Uppers, which was at one time its normal position. In the second group it is noticeable that South African has practically ceased to have a separate quotation at all, for throughout the whole season the price has simply coincided with that of American.

At the opening of the season, with the sharp rise of American, Indian of course lagged behind and fell again into something like its

normal position relatively to American; but during the season it has shown a tendency to hang on very closely to American, and the spot quotation in Liverpool has rarely fallen below 80 per cent. of the price of American.

Looking back now over the whole history of the great depression which began with the Wall Street crash in October, 1929, it is interesting to recall the major movements of cotton prices. In the case of cotton the fall of prices was not due, as in some other commodities, to any over-production or accumulation of stocks, but as the result of the strangulation of demand which followed the depression, stocks began to mount up, and in spite of Government intervention in America and Egypt prices were declining severely in 1931, when the huge American crop of that year completely changed the statistical position and cotton fell very heavily. The enormous carryover at the end of July, 1932, has been reduced by 1,239,000 bales during the past season, thanks to a comparatively small American crop. For the coming season the position has to some extent been saved by the American Government's heroic efforts to reduce the acreage, which, however, have been largely counteracted by the prospect of an almost record-breaking average yield for the coming crop. The result is that the prospective season's supply for 1933–34 is about 1,535,000 bales below that of the previous season; but if the consumption in America maintains the very high figures of the last three months of the past season we may hope for a further moderate reduction in the carryover at the end of this season. The future of American prices, however, lies in the success or failure of the American policy of inflation.

As to Egyptian the statistical position had greatly improved during the past season as the result of the progressive restriction of acreage since 1930 and the small crop of 1932, while the Government's efforts to dispose of their stocks during the past season have been unexpectedly successful and the carryover has been reduced by 1,543,000 kantars. But with the return to a full normal acreage in 1933 and the prospects of a crop of 8,000,000 kantars, of which Uppers will form a very large proportion, there is every prospect of a renewal of the conditions of 1931 when Egyptian, especially Uppers, came much closer to the price of American. Sakel prices are now increasingly affected by the varying fortunes of the Sudan crop. The very satisfactory recovery of the 1931 crop in the Sudan was unfortunately not repeated in the past season, though the failure was not so marked as in 1930, and this should help to maintain the level of Sakel prices against Uppers.

As to the prices of other varieties the inflation of American prices, which has not fully extended to Outside Growths, should place them in a rather more favourable position.

TABLE I.—HISTORY OF COTTON PRICES, 1899–1933.

SEASON'S AVERAGES. SPOT PRICES.

Season.	*Liverpool Prices (Pence per Lb.).*					*Alexandria.*	*American Price of Uplands.*	*Index Numbers of General Prices in U.K.*	
	Sea Island.	*Brazil.*	*American.*	*Indian.*	*Egyptian.*				
	Cents per Lb.	Pernam Fair.	Middling	No. 1 Fine Oomra	F. G. F. Brown.	Dols. per Kantar.	Cents per Lb.	Year.	
1899–00	16·70	5·06	4·87	4·40	6·81	*12·28	7·60	1900	100·0
1900–01	16·40	5·50	5·16	4·37	6·87	13·80	9·30	1901	96·7
1901–02	19·30	4·87	4·78	4·19	6·31	10·42	8·10	1902	96·4
1902–03	†25·00	5·57	5·44	4·47	8·44	13·65	8·20	1903	96·9
1903–04	28·40	5·16	6·94	5·56	8·56	16·65	12·16	1904	98·2
1904–05	27·12	5·25	4·93	4·62	7·37	13·97	8·66	1905	97·6
1905–06	26·38	6·23	5·94	5·00	9·25	15·99	10·94	1906	100·8
1906–07	36·70	6·97	6·38	4·87	10·37	19·16	10·01	1907	106·0
1907–08	35·59	6·79	6·19	5·03	8·81	18·21	11·46	1908	103·0
1908–09	23·39	5·84	5·50	4·94	8·44	15·46	9·24	1909	104·1
1909–10	32·85	8·34	7·86	6·31	13·12	23·30	14·29	1910	108·8
1910–11	35·62	8·27	7·84	7·03	10·75	20·66	14·69	1911	109·4
1911–12	23·73	6·70	6·09	5·63	9·56	17·25	9·69	1912	114·9
1912–13	25·00	7·11	6·76	6·16	9·79	18·28	12·20	1913	116·5
1913–14	23·47	7·47	7·27	5·88	9·45	19·02	13·49	1914	117·2
1914–15	22·00	5·71	5·22	4·46	7·34	12·01	7·94	1915	143·9
1915–16	27·00	8·22	7·51	6·09	10·42	19·28	11·99	1916	186·5
1916–17	50·00	13·03	12·33	10·32	21·56	37·81	18·41	1917	243·0
1917–18	80·00	24·13	21·68	18·78	‡30·97	38·52	28·86	1918	267·4
1918–19	65·00	23·96	19·73	18·13	27·85	37·20	30·36	1919	296·5
1919–20	*Peruvian*	30·00	25·31	19·23	60·84	87·81	38·21	1920	365·7
1920–21	*Tanguis*	13·24	11·89	9·20	30·24	34·50	16·08	1921	229·7
1921–22	Good	11·40	11·37	9·60	19·75	34·28	17·78	1922	185·0
1922–23	16·87	14·62	11·92	11·14	17·29	30·71	24·06	1923	185·3
1923–24	20·15	18·20	17·66	13·35	21·55	39·79	31·67	1924	193·6
1924–25	18·21	14·67	13·76	11·95	29·82	39·49	24·27	1925	185·4
1925–26	15·15	11·09	10·77	8·97	20·05	30·47	19·88	1926	172·5
1926–27	9·95	8·32	8·15	7·18	15·39	21·49	12·96	1927	164·7
1927–28	12·52	11·36	11·17	9·21	19·39	29·69	19·72	1928	163·4
1928–29	12·25	10·72	10·52	8·03	18·14	25·88	18·92	1929	158·9
1929–30	10·44	8·67	9·09	6·39	14·52	20·36	17·24	1930	139·2
1930–31	6·78	5·67	5·71	4·02	9·06	12·04	9·57	1931	121·3
1931–32	6·17	4·86	4·82	4·32	6·80	10·08	5·89	1932	118·6
1932–33	6·98	5·73	5·48	4·84	7·79	§12·26	6·95	1933	‖116·5

* These figures are F. G. F. Brown till 1914, since then composite figures embracing G. F. Sakel, G. F. Ashmuni, and G. F. Brown

† South Carolina. ‡ F. G. F. Sakel. § Nine months. ‖ Eight months.

TABLE II.—SPOT PRICES OF AMERICAN AND EGYPTIAN COTTON IN LIVERPOOL, ALEXANDRIA, AND NEW ORLEANS ON THE LAST FRIDAY OF EACH MONTH.

Month.	Liverpool.					New Orleans	Alexandria.	
	American Middling.	Egyptian F. G. F. Sakel.		F. G. F. Uppers.		American Middling.	F. G. F. Sakel.	F.G.F. Uppers.
	Pence per Lb	Pence per Lb	Premium per Cent	Pence per Lb.	Premium per Cent.	Cents per Lb.	Dollars per Kantar.	Dollars per Kantar.
1930-31.								
August ..	6 64	10·45	*57*	8 50	*28*	10·80	25·87	14·00
September	5·89	10·05	*71*	8·22	*40*	10·06	19·87	13·00
October ..	6·24	9·65	*55*	6·74	*8*	10·89	18·25	12·31
November	5·91	9·35	*58*	6·58	*11*	10·22	16·12	11·43
December	5·31	7·85	*48*	6·09	*15*	9·40	13·75	10·62
January ..	5·63	8·85	*57*	6·52	*16*	10·16	16·25	11·50
February	6·18	10·35	*67*	7·72	*25*	10·81	19·07	13·95
March ..	5·85	9·45	*62*	7·00	*20*	10·59	16·97	12·50
April ..	5·62	8·30	*48*	6·42	*14*	9·89	14·87	11·25
May ..	4·80	7·80	*63*	5·78	*20*	8·45	14·47	10·05
June ..	5·43	8·20	*51*	6·47	*19*	10·21	14·62	11·10
July ..	4·62	6·95	*50*	5·53	*20*	8·37	12·52	8·95
1931-32.								
August ..	3·83	5·95	*55*	4·79	*25*	6·85	10·87	8·20
September	5·19	7·85	*51*	6·15	*18*	5·93	13·62	9·70
October ..	4·99	7·35	*47*	5 82	*17*	6·47	13·22	9·45
November	4·90	7·15	*46*	5·59	*14*	5·99	13·02	9·30
December	5·39	7·05	*31*	5 90	*9*	6·31	12·22	10·05
January ..	5·50	7·35	*34*	6·27	*14*	6·63	13·42	11·00
February	5·79	7·80	*35*	6·83	*18*	7·05	14·32	12·10
March ..	5·15	7·05	*37*	6·15	*19*	6·52	12·17	10·65
April ..	4·82	6·55	*36*	5·77	*20*	5·84	11·47	10·25
May ..	4 45	5 95	*34*	5·33	*20*	5·59	10·67	8·90
June ..	4·41	6 30	*43*	5·53	*25*	5·16	11 42	9·60
July ..	4 67	7·10	*52*	6·14	*31*	5·84	13·32	10·70
1932-33.								
August ..	6·45	8·75	*36*	7·70	*19*	8·52	16·57	13·95
September	5·73	8·35	*46*	7·11	*24*	7·25	15·25	12·55
October ..	5·62	7·80	*39*	7·16	*27*	6·32	14·00	12·75
November	5·44	7·56	*39*	7·03	*29*	5·81	13·60	12·60
December	5·29	7·27	*37*	6·95	*31*	5·95	13·05	12·20
January ..	5·15	7·18	*39*	6·64	*29*	6·11	13 15	11·75
February	4·95	7·02	*42*	6·41	*29*	5·99	12·50	10·65
March ..	5·15	7·10	*38*	6·40	*24*	6·26	12·95	11·07
April ..	5·53	7·45	*35*	6 70	*21*	7·34	13·45	11·82
May ..	6·07	8·17	*35*	7·31	*20*	8·85	14·65	12·78
June ..	6·38	8·37	*31*	7·46	*17*	10·03	15·10	13·42
July ..	6·47	8 48	*31*	7·68	*19*	10·47	15·35	13·87
1933-34.								
August ..	5·53	7·52	*36*	6·77	*22*	9·52	13·20	11·67

TABLE III.—MONTHLY SPOT PRICES OF VARIOUS KINDS OF COTTON IN LIVERPOOL.

ON THE LAST FRIDAY OF EACH MONTH. FROM THE LIVERPOOL COTTON ASSOCIATION'S WEEKLY CIRCULARS.

(For American in Liverpool and New Orleans—and Egyptian in Liverpool and Alexandria—see Table II.)

Seasons.	*Peruvian.*		*Brazilian.*		*West African (Middling).*	*East African (Good Fair).*	*South African (Middling).*	*Indian (No. 1 Fine Oomra).*	*Percentage of Indian on American.*
	Tanguis (Good Fair).	*Smooth (Good Fair).*	*Sao Paulo (Fair).*	*Pernam (Fair).*					
1930-31.									
August ..	7·14	6·94	5·94	5·94	6·59	7·54	6·64	4·10	62
September ..	6·54	6·44	5·69	5·79	5·94	6·89	5·89	3·80	65
October ..	6·84	6·74	6·09	6·19	6·24	7·19	6·24	4·50	72
November ..	6·51	6·41	5·76	5·86	5·91	6·86	5·91	4·20	71
December ..	6·01	5·76	5·36	5·46	5·36	6·36	5·31	3·75	71
January ..	6·33	6·08	5·68	5·78	5·63	6·68	5 63	4·03	72
February ..	7·03	6·63	6·23	6·33	6·18	7·23	6·18	4·58	74
March ..	6·70	6·30	5·80	5·90	5·90	6·90	5·85	4·23	73
April ..	6·47	6·07	5·57	5·67	5·67	6·67	5·62	4·13	73
May.. ..	5·60	5·30	4·80	4·90	4·90	5·90	4·80	3·49	73
June ..	6·18	5·88	5·38	5·48	5·48	6·48	5·43	4·14	76
July.. ..	5·37	4·97	4·57	4·67	4·67	5·67	4·62	3 84	83
1931-32.									
August ..	4·58	4·18	3·78	3·88	3·88	4·88	3·83	3·12	81
September ..	5 99	5·59	5·09	5·19	5·14	6·09	5 19	4·14	80
October ..	6·14	5·64	4·94	5·04	5·04	5 94	4·99	4·36	87
November ..	6·10	5·50	4·80	4·90	4·90	5·80	4·90	4·36	89
December ..	6·59	5·99	5·29	5·39	5 44	6 19	5·39	5·03	93
January ..	6·60	6·10	5·50	5·55	5 55	6 30	5·50	5·43	99
February ..	6·94	6·44	5·84	5·89	5·89	6·64	5·79	5·45	94
March ..	6·27	—	5·17	5·22	5 22	5·97	5·15	4·75	93
April ..	5·97	—	4·87	4·92	4·87	5·62	4·82	4·40	91
May.. ..	5·50	—	4·50	4·55	4·45	5·25	4·45	4·01	90
June ..	5·31	—	4·41	4·46	4 41	5·11	4·41	3 99	90
July.. ..	5·67	—	4·77	4·82	4·77	5·47	4·67	4·33	93
1932-33.									
August ..	7·40	—	6·50	6·55	6·50	7·45	6·45	5·75	89
September ..	6·83	—	5·78	5·83	5·83	6·83	5·73	5·00	87
October ..	6·77	—	5·67	5·72	5·72	6·72	5·62	4·99	89
November ..	6·54	—	5·49	5·54	5·44	6·54	5·44	4·88	90
December ..	6·39	—	5·34	5·39	5·29	6·34	5·29	4·73	89
January ..	6·20	—	5·20	5·25	5·15	6·05	5·15	4·61	90
February ..	6·05	—	5·05	5·10	5·00	5·90	4·95	4·43	90
March ..	6·25	—	5·20	5·25	5·15	6·05	5·15	4·12	80
April ..	6·63	—	5·58	5·63	5·53	6·63	5·53	4·46	81
May.. ..	7·17	—	6·12	6·17	6·07	6·97	6·07	4·86	80
June ..	7·48	—	6·43	6·48	6·38	7·28	6·38	5·14	81
July.. ..	7·57	—	6·52	6·57	6·57	7·37	6 47	5·24	81
1933-34.									
August ..	6·70	—	5·65	5·70	5·60	6·40	5·53	4·40	80

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

486. Report on the Work of the Indian Trade Commissioner during 1932-33. By H. A. F. Lindsay. Much useful and interesting information is contained in this report, the various chapters of which deal with the following: Modern trade tendencies; Agricultural products—foodstuffs and industrial materials; Indian timbers; Lac and shellac; Indian minerals; Trade publicity; Committees and conferences; Staff and acknowledgments. Various appendices are included.

The United Kingdom's imports of cotton from India showed an increase during the year, while imports of cotton from the United States and Egypt declined. In this connection it will be remembered that Lancashire cotton spinners promised, in terms of the Ottawa Agreement, to do all they could to increase their purchases of raw cotton from India, and the Indian Cotton Enquiry Committee, of Manchester, are doing their utmost to stimulate such demands. Imports of cotton-seed from India also showed an increase.

487. Review of Agricultural Operations in India, 1929-30 and 1930-31. (Manager of Pubns., Delhi, 1933.) The low prices ruling for Indian cotton caused the area under cotton to fall from 25,692,000 acres in 1929-30 to 23,616,000 acres in 1930-31. The yield for 1929-30 was 5,200,000 bales of 400 lb. and for 1930-31, 4,820,000 bales.

The work of the Indian Central Cotton Committee in connection with the improvement and development of cotton-growing, marketing, and manufacture of cotton in India is described. An account is also included of the research work financed by the Committee. The Cotton Transport Act and the Cotton Ginning and Pressing Factories Act continue to work smoothly. In connection with Co-operative Cotton Sale Societies, it is stated that during the period under review 25 societies functioned in Bombay, 5 in Madras, 17 in Baroda, and 1 in Mysore.

488. Indian Cotton Chart, 1932-33. We have received from Messrs. Chunilal Mehta and Company, Bombay, a copy of the cotton chart which has been published by them annually for the past nine years at the termination of the Broach contract for April-May delivery. This year's chart gives as usual April-May Broach quotations in Bombay and corresponding quotations for American cotton in Liverpool and New York. The London-New York cross-rate is again included, since it continues to be an important factor. Statistics of the final acreage planted, estimated crop, and yield per acre of the Indian and American cotton crops of 1932-33 are also given on the chart.

489. Improvement of Broach Cotton. We have received from the Publicity Officer of the Indian Central Cotton Committee a note on the research work conducted at the Government Farm, Broach. The research scheme for the improvement of Broach cotton is now financed by the Indian Central Cotton Committee, but for fifteen years, and up to a year ago, the work was conducted by the Bombay Department of Agriculture through its cotton specialists in Gujerat. The area under cotton in the Broach district is about 3 lakhs of acres, the total area in all districts amounting to 8 lakhs of acres. The variety in general cultivation has a high ginning outturn (nearly 40 per cent.), but it is capable of spinning only 16 counts, and in addition is very susceptible to wilt disease. Experiments with various types of Broach deshi and Goghari cottons are being continued with a view to evolving a cotton suitable for the district which will have a high ginning outturn, good spinning value, and be wilt-resistant. Among the

strains selected in the past one called "Broach Deshi 8" is highly resistant to wilt, possesses excellent fibre qualities, and spins 32 counts as against 16 of the original cotton. The ginning outturn, however, is only 33 per cent. as against 40 per cent. of the original cotton, and experiments are in progress to improve this by crossing with high ginning cottons. Another selection recently isolated, called "New Selection 10," promises to be fairly wilt-resistant and has also a high ginning outturn. The experiments are being continued.

490. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

Revised Schedule of Fees for Tests. States the fees payable by mills to the Technological Laboratory, Bombay, for making the following tests on samples of cotton: Fibre or Yarn Test, Fibre and Blow-room Test, and Full Test.

War on Bollworm in the Broach District.—Deals with the intensive campaign carried out by the Indian Central Cotton Committee against the bollworm, which is causing very serious damage to cotton in South Gujerat.

Remove roots with a plant-puller, and thus exterminate the bollworm.—Stresses the need for uprooting the cotton plants immediately after harvesting. The "Cotton Plant-Puller" is suggested as a cheap and useful implement for this purpose.

Punjab Root Rot Scheme.—This scheme has recently been sanctioned by the Indian Central Cotton Committee "for research on the cause of root-rot, and the discovery of methods of controlling this disease," which is stated to cause an annual loss of Rs. 16 lakhs in the Punjab.

The Marketing of Verum Cotton and Seed Distribution in the Central Provinces and Berar.—Describes the working of a co-operative scheme started in 1930-31 by the Central Provinces and Berar with the object of securing adequate prices for the growers and of maintaining supplies of pure seed of the highly wilt-resistant strain, Verum 262.

Spinning Tests on Commercial Indian Cotton.—Deals with the question of spinning tests on samples of cotton submitted to the Technological Laboratory, Bombay, by individual mills, and the fees payable for such tests.

Some Problems of Cotton-Growing and its Rotation Crops in the Central Provinces and Berar.—Discusses the work carried out by the Botanical Section, Nagpur, and at the Akola Farm, under the auspices of the Indian Central Cotton Committee.

491. DESIGN AND CONDUCT OF FIELD EXPERIMENTS. By F. K. Jackson and Y. D. Wad. (*Agr. and Livestock in India*, iii., **3**, 1933, p. 211.) *Summary.* Field experiments are of little or no value unless they have been properly designed and conducted, and their results statistically examined. This entails technical skill, a multiplicity of plots, operations, observations, and calculations. Systematic organization and an efficient technique are therefore essential if a large output of work is to be achieved at a reasonable cost. Such an organization and a simple technique are described in this paper, with devices for labour-saving and for convenience of working. With this organization it has been possible for the Institute of Plant Industry, Indore, to conduct more than a hundred field experiments, both at Indore and at eleven other centres in Central India and Rajputana.

492. A NOTE ON EROSION IN BLACK COTTON SOILS. By Y. D. Wad and G. C. Tambe. (*Agr. and Livestock in India*, iii., **3**, 1933, p. 238.) An illustrated note showing the results of rapid erosion of the drains, grass borders, and cultivated soil by monsoon showers in the fields of the Institute of Plant Industry at Indore. Rat holes, dry-weather cracks, and the sudden downpours of rain are stated to be the agents of erosion.

493. SPINNING TEST REPORTS ON INDIAN COTTONS. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 96-101, 1932-33.) The circulars contain

the grader's report and spinning test results for Surat, Tiruppur, Cambodia, African Busoga, Bailhongal, Farm Western, Jagadia, Navsari, Broach, and Rajpipla cottons for the 1932-33 season.

494. Blow-Room Treatment for a Long-Staple Cotton. By N. Ahmad. (*Ind. Cent. Cott. Comm. Leaflet* 4, 1933.) Gives the results of spinning tests on samples of Sudan Sakel cotton, in which the blow-room treatment was varied with a view to finding out which particular treatment was best suited to a cotton possessing a staple of 1¼ inches. A mild blow-room treatment (only one passage through the Crighton opener and the scutcher) slightly reduced the blow-room loss but increased the card loss; yarns were stronger and more even, but neppy. A still milder blow-room treatment (the same number of passages as above, but the Crighton opener speed reduced from 750 to 500 r.p.m.) further reduced blow-room loss, but made the yarns weak and more neppy, though their evenness was not affected. On the whole, the first treatment was found to be the best one for this cotton, since it resulted in yarns possessing the highest strength and evenness.

495. The Karachi Association. (*Text. Rec.*, li., **603**, 1933, p. 65.) Karachi is growing as a centre of piece-goods trade in India, and is also exporting more cotton. The present annual exports amount to 1,000,000 bales, and it is anticipated that with the success of the Lloyd Barrage there will be a further increase. In view of the increasing importance of the cotton trade, the Karachi Cotton Association has been established, and will shortly take over control of the local cotton market. The constitution of the Association generally follows that of the East India Cotton Association, Bombay, a welcome feature being the establishment of a clearing-house for facilitating payment for cotton dealings.

496. A Note on Cotton of which the Famous Dacca Muslins were Made. By S. R. Deshpande. (*J. of Univ. of Bombay*, i., **4**, 1933, p. 401.) Documentary evidence regarding the famous Dacca cotton is mostly contained in the East India Company's papers. The finest Dacca cotton was grown in a small area of about 40 miles in length by less than 3 miles in breadth, along the banks of the Megna, about 20 miles from the sea. It was used mainly for the manufacture of the famous Dacca muslins, and was never exported. The cotton finally disappeared, mainly because of deterioration caused by bad handling, picking, and mixing.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

497. The following reports have recently been received:

The Journal, South Eastern Agricultural College, Wye, No. 32, July, 1933.
Empire Marketing Board "Ann. Rpt., 1932-33."
Imperial Institute "Ann. Rpt. for 1932."
Cyprus: Ann. Rpt. for 1932.
Gambia: Ann. Rpt. of Dpt. of Agr., 31st March, 1933.
Northern Rhodesia: Ann. Rpt. of Dpt. of Agr., 1932.
Sudan: Ann. Rpt. of Dpt. of Agr. and Forests, 1932.
Ann. Rpt. of Govt. Chemist, 1932.
Ann. Rpt. of Govt. Entomologist, 1932.
Tanganyika: Ann. Rpt. of Dpt. of Agr., 1932.
West Indies: *St. Lucia*, Rpt. of Dpt. of Agr., 1932.
St. Vincent, Rpt. of Agr. Dpt., 1932.

498. Empire Marketing Board. *Annual Report for* 1932-33. (H.M. Stat. Off., 1933. Price 1s. net.) An account of the work of the year given under the heads of Grants for Research and Development; Marketing, Economic Investigation and Market Intelligence; Publicity. New records were established in 1932

in the importation from Empire sources of 24 products enumerated on p. 5. The most promising development in the research activities of the Board during the year was its part in the initiation of a programme of parasitological research at the newly-established Institute of Helminthology at Macdonald College in Montreal. Good progress continued to be maintained in the other fields of research covered by the Board's grants.

499. IMPERIAL INSTITUTE. The Annual Report for 1932, which has just been issued, shows that the work of all the departments has continued to expand. On the technical side, the investigation and intelligence services were extensively utilised by overseas Governments as well as by firms and individuals throughout the Empire, and many important questions relating to the development of Empire resources were dealt with in conjunction with the Advisory Councils and their associated committees.

The nature and variety of the work can be illustrated by a few examples of the subjects on which investigations have been carried out by the Plant and Animal Products Departments; these include: The Standardization of Empire Hardwoods; Empire Sources of Reptile Skins; and Insecticides.

The products received for investigation include practically every class of raw material, and particulars are given of the work on silk, fibres, paper-making materials, oil-seeds, essential oils, tobaccos, and foodstuffs from Empire sources. The subjects dealt with by the intelligence officers show the same wide diversity, as may be seen from a few typical examples, of which details are furnished: the cultivation, preparation, and marketing of plants used for the manufacture of insecticides; the market prospects in this country of sunflower seed, oil and cake; the development of the production of beeswax in East Africa, etc.

The attendance of the public in the Exhibition Galleries has exceeded a million; no less than 2,570 organized parties from schools have attended the conducted tours, lectures, and cinema displays dealing with Empire subjects. The dioramas which have done so much to popularise the Galleries have been increased by the addition of models illustrating scenes in Canada, Northern Rhodesia, India, Australia, and South Africa. There are now over 100 dioramas on view.

500. ASIA. CYPRUS. *Cotton Cultivation.* (*Ann. Rpt. of Emp. Cott. Grow. Corpn.*, 1933.) Notwithstanding the fact that the Agricultural Department estimate that the area suitable for cotton cultivation in Cyprus amounts to about 50,000 acres, of which 33,000 acres are suitable for growing non-irrigated cotton, and the remainder suitable for the crop under irrigation, the island is not at present an important source of Empire supply. In recent years there has been a decline in the output; this is attributed to low prices, the rapid extension of fruit-growing, and the limited supply of irrigation water that can be utilized for cotton production. In addition, the methods of cultivation and subsequent handling of the crop are below the standard of those now followed in the leading cotton-producing countries. If the methods could be improved, the Department of Agriculture are of opinion that a more remunerative market would be open to cultivators, and in that event the production might be very greatly extended. Climatic and soil conditions are favourable for cotton-growing within the area indicated.

The following note on the 1932 season has been received from the Department of Agriculture: "There was an exceptional drought during the year 1932, and consequently the area of cotton planted and the amount of seed produced during that year was the lowest on record. As well as a reduction of the area planted on non-irrigated lands, the area planted under irrigation was also much reduced, due to the shortage of available irrigation water, on account of the failure of the rains. The total average rainfall during the year was only 13·42 inches. The

average for the whole island for the last ten years is 20·47 inches. The area and production for the last five years are as follows:

Year.	*Acres.*	*Lb. Seed Cotton.*	*Yield (Lb. per Acre).*
1928	11,150	2,862,151	257
1929	11,190	4,693,511	419
1930	18,700	6,371,646	340
1931	11,300	3,789,606	336
1932	6,300	1,592,960	253

"The difference in yield per acre is mainly due to the variation in the total area of irrigated cotton grown in any one season, as compared with the area of non-irrigated cotton.

"The above statement of area and production is of particular interest, as the highest and the lowest area and production since the British occupation are recorded during the years 1930 and 1932 respectively.

"The following cotton experiments were carried out during the year: Date of sowing trials, comparative trials with chemical fertilizers of certain types commercially used in Cyprus, spacing experiments, and trials with imported varieties of cotton.

"As climatic conditions are again more normal, the prospects for the 1933 crop, as far as can be foreseen, indicate that an average area will be planted. The actual area of irrigated cotton will depend on the sufficiency or otherwise of irrigation water available during the summer months."

501. AFRICA. GOLD COAST. *Cotton Cultivation*, 1932. (*Bull. Imp. Inst.*, xxxi., 2, 1933, p. 262.) The Director of Agriculture in his report for the period July to December, 1932, states that work on cotton development in the Colony has been aimed at further improving the most promising strain D. 28—a type of American Upland origin bred at Tamale. Results to the end of the year may be summarized as follows:

(i.) D. 28 has now increased its yield, though slightly, for the third year.

(ii.) No other American selection yet approaches this strain for yield, and none shows any great promise at present.

(iii.) One Asiatic variety shows promise, and is early maturing.

(iv.) Soil differences in closely adjacent plots were noted to have marked physiological influence on the same strain of cotton.

(v.) Bollworm was again the major pest. The comparative resistance of the Asiatic varieties is noteworthy (Table I.). The incidence of various pests at different periods of the cotton season is of interest (Table II.).

(vi.) The most serious vegetative disease (leaf-curl), which was a vital factor in the original Allen cotton, is now practically eliminated from the improved strain (Table III.).

TABLE I.

PERCENTAGE INCIDENCE OF DISEASE AND INSECT ATTACK IN SHED BOLLS 1931-32 SEASON.

Strain.	*Stained.*	*Boll-worm.*	*Physio-logical.*	*Other Injuries.*	*Mummied Bolls.*	*Half-Developed Bolls Shed.*
D. 28 ...	12·5	21·4	20·4	19·5	26·2	2·1
T. 66/126 ...	13·1	29·8	22·0	19·8	15·3	3·6
Karunganni ...	11·0	17·2	31·1	19·3	21·4	2·5
Coconadas ...	10·6	15·5	33·3	13·2	27·4	3·5

TABLE II.

MONTHLY PERCENTAGE OF INCIDENCE OF DISEASE AND ATTACK STRAIN D. 28, 1931-32 SEASON.

Month.	*Stainer.*	*Boll-worm.*	*Physio-logical.*	*Other Injuries.*	*Mummied Bolls.*	*Half-Developed Bolls Shed.*
September ...	13·3	25·6	34·5	26·4	—	2·5
October ...	17·7	28·5	24·6	28·6	0·6	2·8
November ...	12·7	22·7	21·0	19·1	24·5	2·1
December ...	8·5	12·7	13·9	11·5	53·4	2·3
January ...	4·2	10·6	14·2	6·0	65·0	1·7
February ...	2·0	15·0	6·3	2·8	73·9	2·4

TABLE III.

INCIDENCE OF LEAF-CURL IN ALLEN AND STRAIN D. 28.

	Percentage of Total Number of Plants Attacked.	
Month.	*Allen.*	*D. 28.*
October	23·2	2·9
November	27·8	3·2
December	40·4	2·1

502. NYASALAND. *Cotton Cultivation*, 1932-33. (*Ann. Rpt. Emp. Cott. Grow. Corpn.*, 1933.) Owing to the continued fall in prices, cotton growing was further restricted by the Government in 1932. Cotton cultivation was only encouraged in the Lower Shire and Chikwawa areas, where a price of $\frac{5}{8}$d. and $\frac{1}{2}$d. per lb. respectively had been paid the previous year. An exception was also made in the case of the Lisungwe area, which was used as a special reservoir for the multiplication of U. 4 seed. No prices were guaranteed, but growers were informed that it was hoped that the prices of the previous year would be maintained. In spite of these circumstances, the demand for seed was far greater than had been expected, and showed that the native cultivators in Nyasaland were anxious to grow cotton at a lower price than was thought likely. The crop for 1931-32 far exceeded the original estimate; indeed, it was larger than the previous year, in spite of the restricted area. This result is probably due to the high yields of U. 4, which are giving great satisfaction to growers. Moreover, it is reported that a very high percentage of the crop is of first grade.

503. *Cotton Crop Prospects*, 1933-34. A report from H.M. East African Dependencies Trade and Information Office states that the previous anxiety which was felt for the cotton crop, as a result of the depredations of locusts, has now subsided, and there is every indication of an excellent crop being marketed. Reports from the cotton-producing areas refer to the healthy condition of the plants, and express entire satisfaction with the prospects for the season.

504. NORTHERN RHODESIA. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr.*, 1932.) The present position with regard to commercial production of cotton is still uncertain. At the Mazabuka Station in the past few years yields of lint have been obtained which would have rendered cotton cultivation remunerative had the Liverpool price been in the neighbourhood of 8d. to 9d. per lb. The value of cotton as a rotation and fodder crop needs no stress. Recent work at the Station has been mainly concerned with the two major pests of cotton—stainers and bollworm—and much further information is needed before reasonable assurances of heavy crops of cotton can be given. At the Fort Jameson Station

U. 4 gave an average yield of 603 lb. seed cotton per acre on virgin land, while a Mazabuka selection from U. 4/4 yielded 721 lb. per acre on older and better cultivated soil. Unfortunately the continued low prices for cotton render its profitable cultivation at this Station improbable for some years.

505. SUDAN. *Cotton Cultivation*, 1931-33. (*Ann. Rpt. of Dpt. of Agr. and Forests*, 1932. Recently received.) The 1931 sowing season in the Gezira was a favourable one. The crop made an excellent start, and its growth and robust appearance were up to the standard of the best crops grown since the initiation of the scheme. Leaf-curl occurred, but did little harm, and it appears that this disease is likely to be seasonal. Blackarm caused damage in certain areas, but good growing conditions continued, and the final yield reached the satisfactory figure of 4·15 kantars per feddan over the whole area. Newly-imported seed from Egypt was sown after being sunned and treated with a germicidal powder at Khartoum North, and ratoons and volunteer seedlings were carefully sought out and as far as possible exterminated. To whatever extent these measures were contributory to the success of the crop, it is evident that the main factor affecting the yield is still the climatic one.

The 1932-33 crop was sown under unfavourable conditions of heavy rains, and consequently considerable areas were put in very late. The precautionary measures taken in the preceding season were again followed, yet not only have blackarm and leaf-curl caused serious damage, but so far, the season being a bad one for cotton, little recovery is taking place. A low yield per feddan is anticipated, and the crop is likely to be rather below the average of those harvested hitherto.

Tokar and Kassala crops of 1931-32 were again good, and though both areas and yields were rather less than those of the previous season, the Tokar yield was above the average. The Gash was sown with its own seed, and Tokar with seed imported from Egypt. In 1932-33 Gash seed has been used on both areas. Leaf-curl is again prevalent in both deltas, but it is difficult to assess the damage from this cause.

The decrease in the amount of American cotton produced in 1931-32, both in the case of irrigated and rain-grown cotton, is mainly attributable to low prices, and it is expected that there will be a decrease in the present season.

Severe damage to cotton was caused by pink bollworm in Berber Province. Dongola Province maintained its immunity from the pest, and this is an important factor in accounting for the abnormally high average yield of 6·17 kantars per feddan recorded on the Government Pumping Schemes in that Province.

Sales of cotton proceeded much more freely in 1932 than in the previous year, and practically all the accumulated stocks of old crops have been liquidated.

No new ginning factories were licensed during 1932, and the existing factories functioned satisfactorily.

506. SWAZILAND. *Cotton Cultivation*, 1932-33. (*Ann. Rpt. of Emp. Cott. Grow. Corpn.*, 1933.) Hitherto cotton-growing in Swaziland has been practically confined to Europeans. During the past year, however, considerable interest in the crop has been shown by the Paramount Chief and his Council. The Corporation promised to assist by giving advice on methods of cultivation and supervising the growing of the crop, and as a result, plots of cotton and food crops have been planted in certain areas under supervision. In addition, small plots of cotton have been planted at schools and mission stations, while a few natives are trying the crop on their own land. The Swazi native is primarily a cattle owner and, with few exceptions, his agriculture is completely undeveloped, and progress in this direction will probably be slow. It is considered, however, that cotton, with its value as a cash crop and its additional value as a rotation crop, will become increasingly popular in areas where it can be cultivated satisfactorily.

507. TANGANYIKA. *Cotton Cultivation*, 1932. (*Ann. Rpt. of Dpt. of Agr.*, 1932.) The decline in production in 1931 was arrested in 1932, and increased crops were obtained in most areas. In the greater part of Shinyanga District U. 4/4/2 seed was issued, this variety being suitable for semi-arid tracts, but unusually heavy rainfall adversely affected the yield. In Mwanza Province a considerably increased acreage was planted, but continuous rains and damage from leaf-curl reduced the yield, so that, in spite of the greater area planted, only a small increase in total production over last year was recorded. In the Eastern Province, Bagamoyo and Rufiji districts, and in Tanga Province, considerably increased yields were obtained.

The Cotton Advisory Board continued to function successfully. The Cotton Cess, imposed with a view to effecting payment for seed and for market supervision of native cotton, has not proved entirely satisfactory, and it is hoped that it will soon be possible to substitute a more effective measure.

Difficulties arose owing to the high cost of transporting natives and their seed cotton to market, the natives complaining of the low prices they obtained. Several methods were suggested with a view to reducing these costs, such as by native group marketing and the zoning of transport areas round markets.

The chief pests encountered during the year were: locusts, stainers, jassid, white fly, pink bollworm, spiny bollworm, and a chrysomelid beetle (*Mesoplatys ochroptera*). The most serious injury to cotton was caused by leaf crinkle.

508. *Cotton Experiments*, 1932. (*Ann. Rpt. of Dpt. of Agr.*, 1932.) At the Morogoro Station a randomized block experiment was laid down to determine the relative values of the various U. 4 strains as compared with the local (American Upland) cotton. The results showed the U. 4 strains to be definitely superior in yield to the local cotton, also earlier maturing and thus less liable to damage from stainers. In a further trial to test the Uganda variety, S.G. 29, against U. 4/4, U. 4/4/10 and Local, the U. 4 strains were significantly superior in yield to Local and S.G. 29. The S.G. 29 strain was the poorest in all-round qualities of any standard variety grown at the Station. At the Lubaga Station selections received from the Barberton Research Station were tried out for the second year, and a number of reselections were made. Increased lint strength was noted particularly in U. 4/4/10 and H. 77. Cambodia cotton proved almost 100 per cent. resistant to jassid attack. During next season efforts to obtain crosses between Cambodia and U. 4 strains will be made with a view to incorporating the jassid-resisting properties with those of a better quality of staple.

509. *Cotton Prospects*, 1933-34. The latest report from the Department of Agriculture is to the effect that in the Eastern Province cotton is withstanding the drought conditions remarkably well at Bagamoyo. At Morogoro prospects are excellent in the northern and southern areas, but in the central, eastern and western areas a considerably reduced crop may be expected owing to the scanty rains. In the Lake Province, cotton is as good as last year in Mwanza and is bolling well. At Maswa the crop has suffered from the drought. In Lindi Province the general prospects are fair.

510. UGANDA. *Cotton Crop*, 1932-33. A report received from H.M. Eastern African Dependencies Trade and Information Office is to the effect that the crop for the season is expected to reach 285,000 bales, which is easily a record figure, and exceeds last season's total by approximately 80,000 bales. Over a million acres were planted. Out of 194 ginneries erected, 134 were licensed during 1932-33, compared with 123 in the previous season.

511. *Cotton Prospects*, 1933-34. The report for July received from the Department of Agriculture states that weather conditions throughout the Eastern

Province have been very dry and unfavourable for cotton planting, but towards the end of June conditions improved, particularly in Busoga District. Taking into account the adverse weather conditions, a satisfactory acreage has been planted in all areas. Some resowing will be necessary. Hot and dry weather conditions have also prevailed throughout Buganda Province, but now the weather is cooler and small local rains are fairly general. Demand for seed has been good, and in spite of adverse weather conditions a satisfactory acreage has been planted, although some replanting will be necessary. In the Northern Province planting was held up by the dry weather. Rains are now fairly general in Lango district and natives are busy planting. In Bunyoro District there is great keenness for cotton planting along the newly opened Tonya road, and large areas are being prepared. A report from Gulu District states that rains are light but are sufficient for germination purposes.

512. WEST INDIES. THE SEA ISLAND COTTON INDUSTRY. (*Trop. Agr.*, x, 7, 1933, p. 200). One of the most important findings of the Conference held in Barbados in March, 1932, was the recommendation that there should be formed in the West Indies an Association of Cotton Growers, a body that would be continually reviewing the position of the Sea Island industry. The original suggestion was that this body should be organized as a limited liability company. A step precedent to the formation of this Association was the formation in each cotton-growing island of a local association, where such a body did not already exist. These local associations took longer to form than was anticipated, and the last of them was created in March of this year. Since all the local associations have now been successfully organized, it will be possible to proceed with the organization of the central body, and it is hoped that the first meeting of the West Indian Cotton Growers' Association will be held early in September.

513. RECENT AGRICULTURAL DEVELOPMENTS IN SOME OF THE LEEWARD AND WINDWARD ISLANDS. By G. A. Jones. (*Proc. of Agr. Soc. of Trinidad and Tobago*, xxxiii., **6**, 1933, p. 171.) *The Cotton Industry.*—Writing of the cotton industry in St. Vincent, the author mentions the fact that for several years the Empire Cotton Growing Corporation maintained a Research Station in the island to look after the interests of the industry, and Dr. Harland was at one time in charge of the work. Later it was thought to be unnecessary to continue the work, and for a few years no special officer was appointed. In 1930, however, the quality of the lint showed signs of serious deterioration, and the Corporation reopened their station and placed a College-trained man in charge under the technical supervision of Dr. Harland. Within three years the quality of the crop has been restored, and the industry now awaits a revival in demand and prices to regain its lost position.

In Montserrat, as in St. Vincent, there was a falling-off in the quality of the cotton, and it was necessary to appoint a well-trained assistant to look after the seed supply. To-day it is a rare thing to find an off-type cotton plant growing in the cotton fields. Seed to be used for planting purposes must be certified by the agricultural authorities, and it is a penal offence to use uncertified seed. Cotton growing by estate owners being no longer profitable, the industry has now largely passed into the hands of the peasants, and estate lands are rented out on the share system.

514. ST. VINCENT. *Cotton Cultivation*, 1932-33. (*Rpt. on the Agr. Dpt.*, 1932.) The area planted to Sea Island cotton was 670 acres and to Marie Galante 800 acres, making a total of 1,470 acres. It is not expected that the yield from Sea Island will be particularly good, since in the first instance cultivation of the land was in most cases roughly carried out, and the subsequent care of the crop, such as weeding, etc., was not all that could be desired. A sharp spell of dry

weather in February seriously retarded the growth of late planted cotton, and in addition high winds caused damage to cotton in exposed positions. The chief pests encountered were the cotton worm (*Alabama argillacea*), pink bollworm, and cotton stainer, but no serious injury was caused to the crop.

515. *Cotton Cultivation*, 1932-33. A report received for the quarter ended June 30 states that the season for Sea Island cotton terminated on May 15, which was the beginning of the Close Season. No cotton will be planted in the island before September next. Returns for the 1932-33 crop are not yet available, but will probably be on a par with those of last year. Insect pests and diseases may be regarded as normal for the season.

516. *Work of the Cotton Experiment Station*, 1932-33. (*Rpt. on Agr. Dpt.*, 1932.) The research work on cotton was continued at the Station, and in connection with this work the Commissioner of Agriculture states: "The Island is indeed fortunate in having located at its Experiment Station a Research Officer carrying on the work of improvement on behalf of the Empire Cotton Growing Corporation, with little expense to the Colony. The action of the Corporation is much appreciated by those interested in the Sea Island cotton industry."

From the report of the Cotton Research Officer for the period September 1, 1932, to March 31, 1933, we learn that, notwithstanding adverse climatic conditions at growing time, good yields were obtained from the seed released in September, which was highly resistant to bud shedding and to angular leafspot. With the exception of cotton stainers, damage from pests was negligible. A species of bug of the family *Tingidæ* was observed sucking at the backs of cotton leaves, and although only sporadic cases were observed, judging from the damage done the pest will bear watching. External boll disease caused a fair amount of loss, but with proper drainage this disease disappears.

Experimental Work.—As a result of purification by selfing and selection, enough seed was obtained of pure V. 135 to plant nine acres in an isolated area in the 1931-32 season. Seed from this area was released in September, 1932, and was sufficient to plant the 1932-33 crop. Test measurements on random samples from estates and from peasants' plots show that the island's crop is pure. The mean maximum lint length obtained from 1,450 measurements of samples representing the cotton of the whole island was 57·4 mm. Thirty acres of a better strain of V. 135 were grown this season at Diamond Estate, by courtesy of the Hon. A. M. Punnett, and a random sample measured 57·7 mm. The Fine Spinners' and Doublers' Association reported that the spinning quality of the cotton was exceptionally good. The seed from this cotton will form the Island's 1933-34 crop.

In connection with Red Sea Island cotton, the back-crossing of this strain to V. 135 was continued in order to eliminate the undesirable genes of the Red Kidney parent. The chief value of this strain lies in (*a*) the facility to spot impure plants, and (*b*) its high resistance to Angular Leafspot and other diseases, and to damage from wind.

Hybridization experiments were also continued, as promising results have been obtained, especially with Moco × Marie Galante crosses.

As a result of Dr. Harland's visit to Carriacou and Union Island a policy has been outlined whereby all the drier Grenadines which grow perennials will have their present cotton substituted by a pure strain of Moco or Improved Marie Galante by 1935. Pure strains of these two types are now available, and can be multiplied for the purpose.

COTTON IN EGYPT.

517. EGYPT. *Cotton Cultivation*, 1933. (*Text. Weekly*, ii., **281**, 1933, p. 543.) The Egyptian Government's first estimate of the area planted to cotton is 1,804,209 feddans, equal to 1,872,769 acres, for the 1933 crop. This increased acreage reflects the abandonment of all restriction policies by the Egyptian Government, and compares with an area planted of 1,093,701 feddans in 1932 and 1,682,938 feddans in 1931. The 1932 out-turn of Egyptian cotton was 4,197,000 kantars, equal to about 840,000 bales of 500 lb. weight.

518. MAARAD COTTON. By F. Bey Abaza. (*Int. Cott. Bull.*, xi., **44**, 1933, p. 661.) Maarad cotton is the longest fine-staple cotton in Egypt, and is also the best yielding of its kind. It is now firmly established as one of the principal varieties, and is popular with growers and with spinners. The production has increased from 320 kantars in 1923 to an estimated 400,000 kantars in 1933. It is not so susceptible to pink bollworm as Sakel, and in ginning out-turn it is also better than Sakel by 1·5 to 2 per cent. The efforts of the Technical Section of the Royal Agricultural Society have resulted in the purity of the strain being maintained, and continuous selection and breeding work is carried out every year to prevent deterioration of the cotton and to improve it in one character or another. Strict supervision is given to prevent as far as possible any mixing of the seed used for sowing.

519. NOTE ON GIZA 7 AND SAKHA 4 COTTONS. By Hussein Enan Bey. (*Int. Cott. Bull.*, xi., **44**, 1933, p. 666.) Giza 7 originated from a single plant selection from a field of Ashmouni, at Fashn, in 1922, and was tested as a pure line selection up to 1926, when one-fifth of an acre was sown with it. The yield is between 32 and 44 per cent. above the yield of Sakel, the ginning out-turn being 31 to 32 per cent., which is about 1 to 2 per cent. above that of Sakel. In fineness and lustre it equals Sakel, but it is slightly inferior in grade and shorter in staple.

Sakha 4 is a cotton highly immune to wilt and should be substituted for Sakel in areas infected by this disease. The yield may vary from 10 to 30 per cent. over the yield of Sakel grown in the same localities. The lint is longer than Sakel, but is not so strong.

COTTON IN THE UNITED STATES.

520. AMERICAN COTTON-GROWING INDUSTRY: PROSPECTS. By A. H. Ulm. (*Cotton* [U.S.], v., **97**, 1933, p. 23. Abstr. from *Summ. of Curr. Lit.*, xiii., **14**, 1933, p. 353.) The writer prophesies that the weather of the next two seasons will not be so favourable for cotton production as 1931 and 1932, and that American production will fall off slightly. The greatest potential competitor with American cotton appears to be Africa, although plant diseases are giving trouble there at the moment. Russian cotton production has increased from 15 to 25 per cent. above the highest pre-war level, but no further increase in acreage is being planned. Russian cotton consumption is going steadily up, and may provide a market for almost the whole American crop in the future. The crop in India depends more on weather conditions than on increase or decrease in acreage, and the extent of the cotton industry in China is unknown. Cotton prices for American cotton will probably rise to about 10 or 12 cents a pound, and will be more stable than for some time past. Production charts are given, and a chart of American consumption of cotton, wool, silk, and rayon.

521. THE 1933 AMERICAN COTTON CROP. By W. Whittam. (*Text. Rec.*, li., **604**, 1933, p. 25.) Discusses the scope and application of the Agricultural Adjustment Act recently passed by the U.S. Congress. The Act confers power " to provide for the reduction of cotton acreage, or production of the basic agri-

cultural commodities, by means of voluntary agreements with producers, and to provide for rental or benefit payments in such amounts as may be necessary."

522. THE U.S.A. INDUSTRIAL RECOVERY PUBLIC WORKS ACT. (*Text. Rec.*, li., **604**, 1933, p. 24.) This Act was signed by President Roosevelt on June 16, and represents a " supreme effort to stabilize for all time the many factors which make for the prosperity of the nation and the preservation of American standards." Concisely, the President is invested with complete authority over every commercial and industrial enterprise in the land. Trade associations, hitherto hampered by legal inhibitions and without power, are now charged with the duty of assembling facts, drawing up codes, and seeing that the terms are carried out. Selling below cost, standardized competition, working conditions, hours, and minimum wages will be subject to supervision by a supervising authority, the National Industrial Recovery Administration, acting for the President. A " code of fair competition " dealing, among other matters, with wages and hours of labour, has been submitted for Presidential approval by the cotton industry, through the three organizations: the National Association of Cotton Manufacturers, the American Cotton Manufacturers' Association, and the Cotton Textile Institute.

523. AMERICAN TEXTILE ACTIVITIES. By W. Whittam. (*Text. Rec.*, li., **603**, 1933, p. 64.) In regard to the suggested use of cotton bagging instead of jute bagging for the American cotton crop, the Department of Agriculture states that " the estimated 200,000 bales required for wrapping the entire crop would be reduced considerably after the first use. The consumption of cotton for bagging, therefore, even with its exclusive use for bagging, would be so slight as not to constitute a real price factor." The *Cotton and Cotton Oil News* also observes that " there is inexcusable waste in our methods of baling and handling, and there is a crying need for reform, but the substitution of cotton for jute manifestly is not the economic agency of improvement."

Writing on the subject of soil erosion, the author states that soil erosion persists as a vital cotton-producing problem, since estimates indicate that erosion takes 21 times as much plant food as the crops take from the land. As a check to this devastation 1 million acres were terraced in Texas last year, making in all some 6 million acres terraced in the State. One result of erosion is that the United States yield of cotton per acre has, on the average, persistently declined.

524. FARMERS' OPINIONS AND OTHER FACTORS INFLUENCING COTTON PRODUCTION AND ACREAGE ADJUSTMENTS IN THE SOUTH. By T. B. Manny. (*U.S. Dpt. Agr. Circ.* 258, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **1**, 1933, p. 132.) Reports the results of a study in which 834 farmers of the Mississippi Delta, the Piedmont, and the South Atlantic Coastal Plain cotton-growing areas were interviewed regarding acreage adjustments. The study showed the need and opportunity for more ingenuity in meeting farm management problems; a hopeful movement toward the home growing of feeds and foods; that acreage adjustments are based too much on retrospect and too little on current conditions or prospects; a recognition by many farmers that there are some opportunities to replace cotton with other crops or farm enterprises; a commendation by the more progressive farmers of the live-at-home campaigns of the extension services; that the live-at-home goal is the most effective means of encouraging cotton acreage adjustments; that members of co-operative cotton-marketing associations are decidedly more likely to use economic information as a basis of adjustments than are non-members; that a majority of the farmers rely on daily papers for economic information, but many are unable to interpret it, and the information is not always sufficient to give an adequate understanding of current conditions; that home economists can render a valuable service in encouraging rational adjustments in the farm

business; and that any attempt to stimulate more rational planning and management on individual farms must take into account not only economic factors, but also social and psychological factors.

525. ARIZONA. *Field Crops Research.* By R. S. Hawkins *et al.* (*Arizona Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **6**, 1933, p. 753.) Investigations included varietal trials, breeding work, and planting tests with cotton; studies of cotton production and soil and climatic environment, and of the relationship between the supplies of nutrients in cotton plants, as indicated by certain plant properties and the abscission of the young bolls.

526. CALIFORNIA. *Cotton Cultivation*, 1933. (*S. Calif. Crops*, ix., **7**, 1933.) The cotton acreage is estimated at 200,000 acres in California, and 57,000 acres in Lower California. The crop has made the poorest start in the history of the crop in the territory, being from two weeks to a month late in most districts. Stands are below normal, and it is considered that unless matters improve in the fall, allowing late picking, the yield per acre will be much below that of last year.

527. FLORIDA. *Cotton Investigations.* (*Rpt. of Agr. Exp. Sta.*, 1932.) During the year the breeding, fertilizer, spacing, time of planting experiments, varietal trials, and inheritance studies were continued, together with investigations on boll-weevil control.

528. LOUISIANA. *Cotton Root Development in Certain South Louisiana Soils.* By H. B. Brown *et al.* (*Louisiana Sta. Bull.* 232, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **6**, 1933, p. 757.) Studies of the development of the roots of cotton plants grown on two soil types revealed that cotton roots grow rapidly, the tap root under favourable conditions extending 0·5 inch per day. Roots of mature plants were thoroughly distributed in the top soil, and extended into the upper subsoil to 1 foot or deeper. Some roots penetrated the deeper subsoil layers, one being traced below a 7-foot depth. The depth of the root system seemed to vary with the soil, most of the roots penetrating much deeper in Sharkey clay alluvial soil than in Lintonia benchland soil. Indications were that the root systems were more extensive in seasons with more rainfall and heavier boll-weevil damage. While subsoiling resulted in deeper root growth, aerating the soil by augur holes or manuring did not cause deeper penetration. The slightly greater acidity of subsoil layers was not enough to affect root growth much, nor were there significant differences due to fertilizer treatment or to variety. Hard layers in the upper part of the subsoil seemed largely responsible for shallow root systems of plants growing on benchland soil in certain years.

529. OKLAHOMA. *Cotton Experiments at the Lawton (Oklahoma) Field Station, 1916-31.* By W. M. Osborn. (*Exp. Sta. Bull.* 209, Oklahoma Agr. and Mech. Coll., 1933.) The short-staple, small-boll, early-maturing varieties of cotton produced slightly larger yields of lint than the medium early maturing varieties with a staple of $\frac{15}{16}$ to 1 inch, and the large boll, late-maturing type with a similar staple. The medium early maturing type proved more desirable when the yields, length of staple, storm-proof character, quality of fibre, lint percentage, and the size of boll were considered. A heavy seed rate did not overcome the difficulty in obtaining a uniform stand in early plantings. Varietal and seasonal effects had greater influence on length of staple and lint percentage than did the time of planting. Single plants spaced 18 inches apart in 44-inch rows produced the largest average yields of lint for a period of seven years. Leaving two plants in a hill resulted in somewhat lower yields in this experiment, regardless of the space between plants or the width of row used. The use of wide rows did not increase the yield of lint. Close spacing hastened the maturity of the crop. The rate of spacing had but little influence on the average percentage of lint or the length of staple.

530. ***Oklahoma Farm Production Costs in*** **1931.** By P. H. Stephens. (*Exp. Sta. Bull. No.* 208, Agr. Exp. Sta., Oklahoma, 1933.) An elaborate analysis of farm costs, including a comparison of the costs of cotton production in south-western Oklahoma in 1929 and 1931.

The average costs of production of 78 farms in Tillman county in 1929 amounted to $36.33 per acre, while in 1931 on 67 of these farms the average cost was $21.69 per acre. The costs per lb. in 1929 averaged 11.77 cents, and in 1931, 7.66 cents. The average yield of cotton in 1929 was 128 lb. per acre, and in 1931, 176 lb. per acre. With practically identical yields in the two years the net profit was $5.18 per acre in 1929 when the lint was sold at 14 cents per lb., and in 1931 there was a loss of $6.92 per acre when the lint brought an average of 5 cents per lb.

531. South Carolina. *Community Production of Cotton in Relation to Yield and Staple Length.* By J. A. Shanklin *et al.* (*Circ.* 48, Clemson Agr. Coll., South Carolina, 1933.) Several studies have been made in South Carolina on the quality and length of staple of cotton produced in the state. Data of this nature are collected at regular intervals, but until recently no effort was made to study the cotton produced in any particular community in order to determine which varieties under field conditions were producing the longer staple length cottons. For this reason, in the fall of 1931, four communities in different parts of the state were selected for study in order to investigate the influence of the source and care of cotton planting seed on the yield and length of staple produced.

Most of the cotton produced in the four selected communities was grown on the following soils: Norfolk sandy loam, Portsmouth sandy loam, Marlboro sandy loam, Johnson loam, Cecil sandy clay loam, and Georgeville clay loam. Each of the four communities produced cotton as the chief money crop of the community, and the soils in each community are considered ideal for cotton production.

The 329 growers were divided into groups as follows: 91 growers of cotton from pure seed of improved varieties; 77 growers of mixed seed of improved varieties; 130 growers of "run-down" short staple cotton; and 31 growers of long staple cotton. The total production was 5,139·6 bales on 8,758 acres.

The average yield of lint per acre from pure seed of improved cotton was 349·4 lb., which was considerably above the yield of 294·9 lb. for cotton produced from mixed seed of improved types, and still higher than the 263·3 lb. for the "run-down" short staple varieties. Only 5·8 per cent. of the acreage in the four communities was long staple cotton, and only two of the communities produced this type of cotton; therefore it is not possible to draw any definite conclusions as to the yield in comparison with the other three variety groups, but it is interesting to note that the long staple cotton outyielded the "run-down" short staple variety group by a few pounds to the acre.

Of the cotton produced from pure seed 73·7 per cent. was one inch or over in staple length as compared with 76·9 per cent. for mixed seed of improved varieties. There was no untenderable cotton produced from pure seed, and only 1·9 per cent. of the cotton from mixed seed was classed as untenderable. In the "run-down" short staple variety group, only 3·3 per cent. of the cotton was one inch or longer, while 26·9 per cent. of the cotton was untenderable. Of the long staple cotton 96·9 per cent. was $1\frac{1}{8}$ inches or longer, and the remaining 3·1 per cent. was $1\frac{1}{16}$ to $1\frac{3}{32}$ inches in length.

532. ***Farm Prices of Cotton Related to its Grade and Staple Length in Selected Local Markets, Seasons*** **1930-31** ***and*** **1931-32.** By J. S. Burgess, Jr., and M. Guin. (*Bull.* 290, Clemson Agr. Coll., S. Car., 1933.) "Cotton prices paid to growers in South Carolina do not accurately reflect differences in the spinning value of the different grades and staple lengths. These prices varied so

irregularly on the basis of grade and staple length during the seasons of 1930-31 and 1931-32 that it was not unusual for some farmers to receive considerably higher prices for some grades and staples than other farmers received for higher grades and longer staples sold in the same market on the same day.

"Lack of knowledge of the correct classification and commercial value of cotton, differences in the character of cotton, inadequate volume of some grades and staple lengths, and differences in bargaining power of farmers are considered the principal factors responsible for growers not receiving a larger proportion of central market premiums and discounts for grade and staple length.

"The present marketing practices can be improved by (1) having disinterested, competent, and reliable persons classify the cotton according to a uniform standard, and issue a certificate showing the grade, staple length, and character of each bale before it is sold by the grower; (2) encouraging the production of cotton of more uniform quality in each community, so that the volume of cotton of each quality produced will be large enough to be handled more economically; and (3) supplying farmers with more adequate information on cotton prices in central markets and in nearby consuming centres.

533. *Field Crops Experiments.* By H. P. Cooper *et al.* (*S. Car. Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 68, 6, 1933, p. 754.) Contains progress reports on many subjects, including varietal, fertilizer, and cultural tests with cotton, also research embracing physiological studies, effects of soil moisture and temperature on germination and seedling growth, seed treatments, cold resistance of seedlings of varieties and strains, time of picking tests, and study of length and structure of fibres especially as affected by soil moisture conditions.

534. TEXAS. *Fattening Lambs on Corn, Milo, Hegari, Wheat, and Oats, with Cottonseed Cake and Alfalfa.* By A. K. Mackay and J. M. Jones. (*Texas Sta. Bull.* 465, 1932. Abstr. from *Exp. Sta. Rec.*, 68, 5, 1933, p. 656.) The addition of cottonseed cake to a ration of alfalfa and grain resulted in a marked decrease in the amount of grain and hay required per unit of gain, and when added to a ration of whole threshed sorghum grain and alfalfa increased the rate of gain. The productive value of cottonseed cake in a ration of threshed milo and alfalfa was appreciably higher than its calculated value in a balanced ration. Cottonseed cake increased the appetite of the lambs and improved their carcasses because of the higher finish.

COTTON IN FOREIGN COUNTRIES.

535. THE COTTON FAMINE ON THE CONTINENT, 1861-65. By. W. O. Henderson. (Reprint from the *Econ. History Review*, 1933.) An interesting account dealing briefly with the effects of the cotton famine of 1861-65 on the cotton industries of France, Germany, Switzerland, Russia, and Italy.

536. ARGENTINA. *Cotton Cultivation.* (*Int. Rev. Agr.*, Rome, xxiv., 6, 1933, S397.) Favourable weather prevailed during January and February, but a drought set in later and caused some damage to the cotton crop. It is estimated that production will be from 15 to 20 per cent. lower than last year. Damage by locusts has been slight. There have been several invasions of cotton worms, but owing to the energetic defensive measures adopted by growers, this has not affected the yield very much, the reduction in the crop being due rather to the drought.

537. BELGIAN CONGO. *Cotton Crop*, 1932-33. (*M/c. Guar. Coml.*, 12/8/33.) The latest cotton reports from the Belgian Congo indicate that the situation is satisfactory. The crop in Katanga will, it is believed, amount to between 5,000 and 6,000 tons, or about 1,000 tons more than had been counted on. In the

Lomani, as well as in the Ruzizi, the harvest is decidedly more than had been expected, some plantations having produced more than twice the calculated crop.

538. The Cultivation of Cotton in the Belgian Congo and at the Bambesa Breeding Station. By J. Menendez Rodriguez. (In Spanish.) (*Agricultura*, **5**, p. 96. Madrid, 1933. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 195.) Stations have been established for selection in each cotton area, with secondary stations for multiplication of seed. Of the former, Bambesa is the one for the northern region. The object is to combat the disastrous fall in productivity and quality which has come about in recent years. The methods of mass and pure line selection employed are briefly outlined, with indications of the very considerable improvement effected, and points to be borne in mind on judging the quality of the fibre.

539. Brazil. *Cotton Cultivation in São Paulo.* By W. W. Coelho de Souza. (*Rev. Text.*, iii., **2**, 1933, p. 9. Abstr. from *Summ. of Curr. Lit.*, xiii., **10**, 1933, p. 243.) The present state of cotton cultivation in São Paulo is discussed, and details are given of the methods of cultivation, area, and production of one enterprising firm. The classification into nine types of 4,080 bales of cotton produced by this firm is shown, and a table showing the length distribution of cottons grown in São Paulo and in other states is given. The good quality of the cotton produced by another company is pointed out, and further developments and improvements in cotton cultivation in this district are predicted.

540. China. *Cotton Cultivation.* (*Text. Weekly*, ii., 282, 1933, p. 567.) Reports indicate that there will be an increase in cotton acreage this season. In Manchuria a cotton-growing association has been formed, and a twenty-year programme drawn up. Cotton has been grown to a limited extent in this country, but climate and soil conditions do not appear to be favourable.

541. Association Cotonnière Coloniale. *Bull. No.* 11 is a special number containing an interesting and profusely illustrated report of a mission undertaken by M. Hesling, Director-General of the Association Cotonnière Coloniale, to enquire into the whole question of cotton-growing in the Cameroons and French Equatorial Africa.

542. Cotton Culture in French West Africa. By L. Robert. (*La Culture du Coton en Afrique Occidentale Française*, Paris, 1931. Abstr. from *Exp. Sta. Rec.*, 68, **5**, 1933, p. 611.) This treatise discusses general conditions in the African cotton industry; gives details of cotton production in Upper Volta, Ivory Coast, Sudan, Dahomey, Niger, Senegal, Guinea, and Mauritania; and describes the status of the industry in those regions, with a list of various agencies interested in cotton. A bibliography is appended.

543. Japanese Cotton Industry: Competitive Strength. By F. E. Holsinger. (*Text. Weekly*, ii., 1933, p. 235. Abstr. from *Summ. of Curr. Lit.*, xiii., **11**, 1933, p. 301.) The author suggests that the abnormally low price of Japanese cotton goods which are flooding the market is due to low cost of production, owing to low wages and long hours, and to the fact that the Japanese manufacturer reinvests his profits in the industry, and foregoes profits which could only be accumulated and not used. The raw cotton coming to Japan as interest on capital invested abroad cannot be used up in Japan, and so is in effect given away.

544. Japanese Cotton Operatives: Psychological Research. By H. M. Vernon. (*Human Factor*, **7**, 1933, p. 178. Abstr. from *Summ. of Curr. Lit.*, xiii., **13**, 1933, p. 352.) A summary of a report by the Institute of the Science of Labour in Japan on investigations on women operatives in the Japanese cotton mills.

545. INDUSTRIAL CONDITIONS IN JAPAN. (*Int. Cot. Bull.*, xi., **42**, 1933, p. 401.) The International Labour Office has recently issued an important report entitled "Industrial Labour in Japan" (London: P. S. King and Son, 10s.), which is the first of a series of studies of industrial conditions in the East. The report has been compiled in co-operation with the Japanese Government, and contains information otherwise inaccessible.

Recruitment of Labour.—The system of loans to parents, repaid from the wages of the young people, is described. It results in what is practically indentured labour, and the system is on the decrease.

Working Hours.—The statistics of hours of work are conflicting. The labour census of 1927 showed prevailing hours of work in silk filatures to be just under 11 a day, and in cotton spinning and weaving just under 10 hours. The Bureau of Statistics gives 9 hours 32 minutes as the average day in textiles in 1930, which reflects the effect of the abolition of night work in cotton spinning in 1929, which reduced hours in this branch from 10 to 8½. According to the 1927 census of labour, 8 per cent. of the cotton workers worked overtime, to the average extent of 42 minutes a day in spinning and 48 minutes in weaving. During the last few years the number of permits for overtime working up to 2 hours daily and for 7 days a month, on the grounds of temporary pressure of work, has grown. Most of the permits were for the textile industry, and particularly the weaving mills, which obtained 6,985 out of the 10,152 permits in 1930.

Textile Wages.—Material on Japanese wages is difficult to judge. There are few collective agreements, for only some 7 per cent. of the workers are organised. The average daily wages in the cotton spinning and weaving industries are given as follows (the earnings including bonuses, allowances, and payments in kind):

AVERAGE WAGES PER DAY IN YEN.

	1928.	1929.	1930.	1931.
Cotton spinning:				
Male	1·65	1·61	1·50	1·45
Female	1·12	1·06	0·91	0·79
Cotton Weaving:				
Male	1·32	1·41	1·28	1·26
Female	0·91	0·93	0·74	0·70

In the past three or four years there has been a steady decline in the wages of factory workers. The decline in 1930 and 1931 is attributed to the increasing severity of the trade depression. The report complains of the lack of data for constructing reliable index numbers of the cost of living in Japan. The conclusion is drawn that retail prices have declined considerably during the last five years, and there has been an advance in real wages. The average number of working days per month has, however, slightly declined in recent years, and the workers are earning less per month now than a year or two ago.

546. WHY JAPAN IS ABLE TO UNDERSELL. By A. Raymond. (*Ind. Text. Journal.* Abstr. from *Text. Rec.*, li., **604**, 1933, p. 29.) In this discussion of Japanese competition and its bearing on the Indian mill industry, the author deals with the question of freight, hours of labour, number of looms per weaver, payment of operatives, the effect of exchange tampering, and Customs duties.

547. RUSSIA. *Cotton Acreage.* (*Text. Weekly*, ii., **282**, 1933, p. 567.) There are indications of a 15 per cent. reduction below 1932 in the 1933 cotton area of the chief Russian producing regions. This is largely due to the unfavourable spring weather. Special efforts are under way to secure higher yields through improved cultivation and irrigation, and to prevent loss by insect damage.

SOILS AND MANURES.

548. Soils: Their Origin, Constitution, and Classification. An Introduction to Pedology. By G. W. Robinson. (Thos. Murby and Co. Price 20s. Abstr. from *Trop. Agriculturist*, lxxx., 5, 1933, p. 316.) This book, the first by the author, is a welcome addition to the few books in English on pedology. The aim of the writer is to give within the compass of a book of moderate size a general view of the subject, and it will generally be admitted that he has succeeded remarkably well in achieving it. The first section deals with the origin, constitution, and properties of soils. In these chapters great stress is placed on the importance of the soil profile, which the author rightly considers should be the unit of study in all future pedogenic work. The next section is devoted to a description of the chief soil groups of the world, a discussion of the problem of classification, and a general account of the geographical distribution of soils. The remaining section consists of chapters on soil surveys and soil analysis, and concludes with a brief discussion on the inter-relationships of soil conditions, plant growth, and agriculture. The appendix contains descriptions of the principal routine determinations necessary for the characterisation of soils. The book is well got up and fairly well illustrated. At the end of each chapter is a useful bibliography on the subject matter covered in it. An index of places and a comprehensive subject index are also included.

549. Experimental Methods for the Study of Soil Cultivation. By B. A. Keen. (*Emp. J. Exp. Agr.*, i., 2, 1933, p. 97.) The direct study of cultivation processes has only recently been taken up in detail. Apart from the obvious factor of weed-destruction, cultivation may be regarded as a mechanical aid to the formation of the small soil aggregates—or crumbs, or "compound-particles"—that are characteristic of a soil in good tilth. The primary effect is a disintegration of large pieces of soil into smaller ones. The experiments on which the present paper is based deal with this aspect of the problem, in relation to different implements and weather conditions. The conclusions refer only to the Rothamsted soil—a medium to heavy clay loam containing numerous flints—under a temperate climate with a well-distributed rainfall. As it is desirable that experiments should also be done under different conditions of soil and climate, certain important details of experimental procedure are included in this paper for guidance.

550. Interaction between Ammonia and Soils as a New Method of Determining the State of Saturation and pH Values of Soils. By A. N. Puri. (*Ind. J. Agr. Sci.*, ii., 6, 1932, p. 710.)

551. On the Nature of the Reactions Responsible for Soil Acidity. II. Titration Curves of Silicic Acid Sol, Humic Acid Sol, and Aluminium Hydroxide Sol. By J. N. Mukherjee *et al.* (*Ind. J. Agr. Sci.*, ii., 6, 1932, p. 638.)

552. Soil Erosion. (*Imp. Bur. Soil Sci.* [*Harpenden*] *Tech. Comm.* 5, 1931. Abstr. from *Exp. Sta. Rec.*, 68, 6, 1933, p. 736.) Following an introduction which stresses the importance of the problem, and indicates the widespread interest taken by various governments, the paper contains a section descriptive of various quantitative experiments, including some of those carried out in the United States; a section on preventive measures; a section on terracing and drainage; a list of the references cited in the paper; and a bibliography which "contains all the references on soil erosion filed at the bureau."

553. Soil Erosion: Supplementary Note. (*Imp. Bur. Soil. Sci.* [*Harpenden*] *Tech. Commn.* 16, 1931. Abstr. from *Exp. Sta. Rec.*, 68, 6, 1933, p. 736.) This is supplementary to *Technical Communication* 5, above noted, its object being

" to bring the information up to date and to complete the bibliography." The present paper takes up experiments in Nyasaland, Uganda, Missouri, Tennessee, Texas, and California, and on physical and chemical properties related to erosion. A supplementary bibliography is included.

554. Soil Erosion. By T. Eden. (*Tech. Commn.* 28. Pubd. by the Imperial Bur. of Soil Science, Harpenden, England, 1933. Price 2s.) This technical communication aims at presenting in a concise form modern knowledge of the extent of soil erosion damage, its underlying causes and methods of prevention. It is based mainly on the bibliographical index on the subject in the files of the Imperial Soil Bureau. No attempt has been made to give a complete bibliography, since this would involve much overlapping in references, but the most representative papers are summarized and cited. The question of prevention is dealt with in general terms. Local circumstances must inevitably guide technicians and agriculturists in their choice of specific remedies, especially in the selection of crops and rotation. Two points of view have been prominent in the mind of the compiler: firstly, that of the scientific worker who may have soil erosional investigations in hand at his own station; and, secondly, that of the propagandist officer who is striving to awaken the agricultural conscience in the matter. With these ends in view, data are quoted and methods reviewed in some detail, which it is hoped will provide a reasonable conspectus of present conditions.

The following are the headings of the various sections: Extent of Damage Due to Erosion; Types of Erosion; Erosion and Rainfall Distribution; Measurement of Run-off and Erosion; Interaction of Soil Type and Condition with Erosion; Soil Properties Conducive to Erosion; Loss of Nutrients caused by Erosion; Preventive Measures; Programme of Soil Erosion Investigations; References Cited.

555. The Fight against Soil Erosion. By M. J. van der Spuy. (*Farming in S. Afr.*, viii., 87, 1933, p. 222.) Experiments carried out at the School of Agriculture, Grootfontein, South Africa, have shown that barricades of wire-netting can be successfully used in combating soil erosion, except where the slope is very steep. The silt and debris brought down by the storm-water, and caught by the netting, not only deepen the soil in that vicinity, but also enable the rainwater to soak into the ground, and render the growing crops more resistant to drought or the vagaries of the rainfall. Wire-netting cannot be used, however, where the gradient is 1 in 100 or steeper, since the barricade could not be made sufficiently strong to withstand the volume of water brought down, or the velocity of its flow during or after a heavy thunderstorm. In such cases it would be necessary to throw up rubble embankments reinforced with wire or concrete.

556. Erosion of Cultivated Lands. Practical Combative Measures. By Dr. J. C. Fick. (*Farming in S. Afr.*, viii., 86, 1933, p. 173.) The following measures are suggested for the prevention of washaways on land: Avoidance of lands with very steep slopes; building of strong embankments and contour walls to dam the storm-water; provision of grass-covered strips about 50 to 100 yards apart to retard the flow of the water; ploughing under of a green manure crop to renew the humus which binds the soil together and prevents erosion. For the prevention of wind erosion the following measures are suggested: Breaking up the land into clods with a disc cultivator to roughen the surface; planting suitable trees as windbreaks; fertilization of the land and the establishment of grass or other permanent fodder crops to afford adequate cover to the soil, and to protect it from wind erosion.

557. Terracing to Control Erosion. By J. S. Glass. (*Kans. State Coll. Ext. Bull.* 70, 1932. Abstr. from *Exp. Sta. Rec.*, 68, 6, 1933, p. 829.) A large amount of practical information is given in this well-illustrated publication on terracing

and gully control. It appears that the broad base terrace having a slight grade is best adapted to Kansas conditions.

558. Types of Terracing Machinery Used in Texas. By H. P. Smith. (*Agr. Eng.*, xii., **2**, 1931, p. 43. Abstr. from *Circ. No.* 61, 1931. A. and M. Coll., Texas, Div. of Pubns.) A brief description of the types of machinery used for terracing in Texas. In tests of the efficiency of terracing machines, it was found that the efficiency is directly proportional to the ability of the blade to penetrate the soil and to its scouring qualities.

559. Sierra Leone. *Soil Survey.* By F. J. Martin and H. C. Doyne. (*Dpt. of Agr.*, Sierra Leone, 1931. Abstr. from *Trop. Agr.*, x., **6**, 1933, p. 178.) This pamphlet presents a brief description of the climate, agriculture, geology, and soil types of Sierra Leone; it provides a valuable contribution to the knowledge of West African soils. A preliminary report on soil survey work, carried out in Sierra Leone up to the end of 1925, was issued in 1926 by Dr. Martin; it was based on the laboratory examination of some 600 soil samples. Since 1926, some 900 further samples have been examined. Data appertaining to all these soils are tabulated in an appendix to the pamphlet. In most cases the soils were sampled in profile to the 4-foot depth. The soils are classified into: Laterite soils; laterite gravels; red sandy soils; brown sands and sandy loams; coarse sandy soils; swamp soils; and black or brown grit soils.

560. The Behaviour of the Water Content and Cations of Mineral Soils. By P. Vageler. (*Der Kationen- und Wasserhaushalt des Mineralbodens.* Berlin: Julius Springer, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **5**, 1933, p. 593.) Following a brief foreword and an introduction further emphasizing the close interrelation of all the widely diversified phenomena of the soil, the remaining chapters include the following: A statement and examples of the problem; physical fundamentals; the soil substances having a sorption capacity, and the nature of their complexes; the water-supply and the water-balance of the soil; the soil as a source and carrier of nutrients; and investigational and analytical methods. A bibliography, author index, and subject index are appended.

561. Estimation of Plant-Available Phosphate in Soil. By P. L. Hibbard. (*Soil Sci.*, i., **35**, 1933, p. 17. Abstr. from *Exp. Sta. Rec.*, 68, **6**, 1933, p. 728.) A general schedule for the estimation of that part of the phosphate content of the soil which will be available to plants is thus outlined: "Test for carbonate by adding HCl, and determine pH by a suitable indicator, cresol red or phenolphthalein. If the soil effervesces or has a pH over 8, it is to be considered as alkaline, and must be tested for PO_4, by other special methods. If the soil is not alkaline, make the Truog test. If the PO_4 is very high or very low, no other test is needed to characterize the soil. If the Truog test indicates a medium amount of PO_4, other tests are needed. Make water extracts 1/1 or 1/4 and 1/100. If the concentration of PO_4 in both is above 0·2 p.p.m., and above 500 in the Truog test, no other test is needed, but if the Truog test is 300 or less, it may be well to make the test by percolation with water and with 0·05 NH_2SO_4."

The interpretation of the results of the determinations indicated is discussed in some detail.

562. Handbook of Plant Nutrition and Fertilizer Theory. I. Plant Nutrition. II. Fertilizer Materials and their Use. Edited by F. Honcamp. (Berlin: Julius Springer, 1931. Abstr. from *Exp. Sta. Rec.*, 68, **5**, 1933, p. 595.) The first of these two volumes contains historical notes on the development of plant nutrition, data on the constituents and composition of the plant body, the cycle of natural materials, the physiology of the metabolism of plants, the soil as a medium and foodstuff reserve for the plant, the law of returns, solution

culture and vegetation experiments, the field experiment, the evaluation of fertilizer experiments, and the determination of the nutrient needs of soils, as well as a subject index. The second discusses the materials and use of fertilizers, natural and artificial fertilizers, the application of artificial fertilizer materials, the use of fertilizers for agricultural crop plants, forestry, moor and meadow soils, and in ponds, and plant protection and the use of fertilizer materials, as well as a subject index.

563. Soil and Fertilizer Studies in South Carolina. By H. P. Cooper *et al.* (*S. Car. Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 68, 6, 1933, p. 734.) Data are reported as to the difference in response of soils to additions of calcium arsenate, relations of soluble phosphate fertilizer and soil characteristics to arsenic toxicity, management of soil affected by additions of calcium arsenate, comparison of sodium nitrates from various sources, experiments with potash fertilizers as to time of application, symptoms of potassium, manganese, and magnesium deficiency in crops, soil acidity and the use of limestone for cotton, machine placement of fertilizers for cotton, etc.

564. Uganda. *Analyses of Fertilizers.* (*Ann. Rpt. Dpt. of Agr. Uganda*, 1931. Pt. II., p. 65.) From the report of the Agricultural Chemist we quote the following: "Four local fertilizer materials were analyzed, and for comparison an average analysis of farmyard manure is given:

	Cotton Seed Ash.	*Cotton Seed.*	*Coffee Pulp.*	*Coffee Parchment.*	*Average Farmyard Manure.*
	%	%	%	%	%
Moisture ...	16·9	32·7	46·7	20·7	76·11
Ash ...	61·2	7·9	15·1	3·8	—
Phosphate ...	11·2	1·23	0·03	0·16	0·23
Potash ...	14·1	1·37	2·10	1·45	0·56
Nitrogen ...	1·28	2·21	1·13	0·44	0·55

"The best balanced fertilizer is cotton seed, which is about four times as concentrated as farmyard manure. A general purpose dressing of three tons per acre has given good results. The sample of cotton seed ash was not completely burnt, and contained one per cent. of nitrogen. As it is usually to be had for haulage costs, it is being tried on tobacco."

565. The Effect of the Contact of Chemical Fertilizers with Seeds on their Germination. By V. G. Gokhale and P. M. Gaywala. (*Agr. and Livestock in India*, iii., 3, 1933, p. 256.) Experiments showed that contact of sulphate of ammonia with cotton seed under moist conditions adversely affected germination. Contact of the fertilizer with the seed, up to two days, under dry conditions, made no appreciable difference to the germination of the seed.

566. Influence of Green Manure and Organic Residues on Nitrogen Fixation in Soil. By S. V. Desai. (*Ind. J. Agr. Sci.*, iii., 2, 1933, p. 301.) A statistical analysis of the results of experiments. Fixation of nitrogen takes place when green manures, farmyard manure, straw, or any other organic materials are added to the soil under favourable conditions of temperature, moisture, and aeration. Quicker results were obtained from the application of fermented green manures, but the amount of nitrogen fixed was greater with unfermented manures.

Various experiments conducted in artificial media indicated that azotobacter, radiobacter, *B. radicicola*, clostridia, and nitrogen fixing organisms from farmyard manure were responsible for increase in atmospheric nitrogen. No loss in nitrogen during storage or decomposition of the nitrogenous materials occurred if conditions maintained were absolutely aerobic throughout the experimental period.

567. The Effect of Fertilizers on the Variability of the Yield and the Rate of Shedding of Buds, Flowers and Bolls in the Cotton Plant in Surat. By P. C. Mahalanobis. (*Ind. J. Agr. Sci.*, iii., **1**, 1933, p. 131.) The results of experiments are analysed statistically. The conclusion is drawn that the mean number of buds, the mean proportion of flowers to buds, and the mean proportion of bolls to buds are all altered appreciably by the addition of fertilizers. The variability of the production of flowers is altered, but not the mean number of flowers. This possibly has caused a just appreciable effect on the variability of the proportion of flowers to buds. In the case of bolls and the proportion of bolls to buds, neither the mean values nor the variabilities appear to have altered appreciably.

568. The Effect of Different Doses of Nitrogen on the Rate of Shedding of Buds, Flowers and Bolls in the Cotton Plant in Surat. By P. C. Mahalanobis and S. S. Bose. (*Ind. J. Agr. Sci.*, iii, **1**, 1933, p. 147.) The results of experiments are analysed statistically. Doses of nitrogen increased the number of flowers per plant, and additional doses stimulated the formation of flowers from buds and of bolls. Applications of nitrogen increased the percentage success of buds growing into flowers, and the rate of shedding of buds was diminished. The percentage success of buds developing into bolls was also increased.

569. The Effect of the Time of Application of Fertilizers on the Yield and the Rate of Shedding of Buds, Flowers, and Bolls in the Cotton Plant in Surat. By P. C. Mahalanobis and S. S. Bose. (*Ind. J. Agr. Sci.*, iii., **1**, 1933, p. 139.) A statistical analysis of the results of experiments. Fertilizer was applied in July and August, and the following factors were studied: The production of buds, flowers, and bolls, and the percentage of buds developing into flowers, flowers developing into bolls, and buds developing into bolls. Fertilizing in July gave a significant increase in the yield of buds and flowers, and although it showed an appreciably greater rate of shedding of buds, the increase in the final yield of bolls was found to be significant. August manuring made no appreciable difference to the number of buds, flowers or bolls, or to the rate of shedding.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

570. Importance of Subsoil Moisture in Cotton-Growing. By W. G. Wells. (*Queensland Agr. J.*, xxxix., **5**, 1933, p. 213.) The following conclusions are presented by the author: The cotton plant has a root system of the deep tap-root type, which exhausts the subsoil moisture to a marked extent, especially during a season of light rainfall following a dry winter. It is advisable, therefore, to grow cotton in rotation with shallow-rooted fodder crops, which can be harvested in time to allow of ploughing in late March, April, or May. Experiments at the Cotton Research Station, Callide, have demonstrated that ploughing during this period not only helps to conserve the late summer rainfall, but assists most decidedly in obtaining greater benefit from any winter rains that may occur. Where large acreages of cotton are grown, it is advisable that at least half of the area be planted on early-ploughed land following a summer crop. Only half of the old cotton land would thus be required for the new crop, and usually this could be ploughed in time to conserve an appreciable amount of any winter rains occurring. Rotations of either sorghums and cotton, panicums and cotton, or maize and cotton, are suitable for the rich alluvial soils. Rotations of either cotton, cowpeas, and sorghums, or cotton, cowpeas, and panicum, are suitable for the poorer alluvial soils and clay or clay loam forest slopes. During the first two or three seasons after either forest or scrub soils are brought under cultivation,

profitable yields of cotton can be confidently expected under a wide range of climatic conditions. It is possible that on the rich alluvial and scrub soils a rotation where three years of Rhodes grass are followed by one year cotton, one year maize or panicum, and one year cotton, after which the land will be put back again into Rhodes grass for three years, may likewise be of marked value under a wide range of climatic conditions. Ploughing early to a depth of 6 in. and preparing the seed-bed by the end of July will give gains in yields over a series of years. Late cross-ploughing should be avoided, if possible—it dries out the upper soils, and thus necessitates very good planting rains being experienced if the cotton seedlings are to be able to withstand early dry conditions. If it is necessary to follow cotton with cotton, it is advisable to cut and burn the old stalks, and plough as early as possible. The new crop should be planted in the middle between the old rows, rather than again on top of them.

571. The Callusing and Rooting of Cotton Stem Cuttings. By H. E. Rea. (*Plant Physiology*, **4**, 1932, p. 733. Abstr. from *Circ. No.* 68, p. 31, 1932, A. and M. Coll. Texas Div. of Pubns.) The callusing and rooting of cotton stem cuttings were tested under variations of maturity of cutting-wood, conditions of cuttings before placement, and protection provided in the cutting bed. The highest percentages of rooted cotton cuttings were secured from mature wood cuttings in exposed greenhouse beds of quartz sand. A number of cuttings of horticultural plants were studied under identical conditions provided for the cotton. Compared with the results secured with the horticultural cuttings, the results with cotton cuttings were mediocre.

572. Water Requirements of Cotton on Sandy Loam Soils in Southern San Joaquin Valley. By S. H. Beckett and C. F. Dunshee. (*Calif. Sta. Bull. No.* 537, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **4**, 1933, p. 470.) The irrigation requirements of cotton grown on Delano sandy loam soils and the effects of soil moisture deficiency on growth and yields were studied from 1926 to 1930, inclusive, at the U.S. Cotton Field Station at Shafter, in the San Joaquin Valley of California. A general description of the soil types, water supply, and climate of the area is given, with results of preliminary observations of irrigation practices on commercial fields.

573. The Effect of Latitude, Length of Growing Season, and Place of Origin of Seed on the Yield of Cotton Varieties. By G. A. Hale. (*J. of Agr. Res.*, xliv., **8**, 1933, p. 731.) The approximate latitude and number of frost-free days were determined for thirty-seven locations where cotton varietal tests have been conducted in Georgia for a period of at least three years. The same data, the relative yield, the average annual yield, and the place of origin of seed were determined for the varieties tested at each location. A correlation coefficient of −0·143 for relative yield and differences in latitude at the test location and place of origin was found. A coefficient of −0·118 for relative yield and differences in number of frost-free days at test location and place of origin was found. Information on the comparative yielding ability of local and introduced cotton seed in sixty-eight experiments located in four States is given. Locally grown seed outyielded introduced seed in 60·3 per cent. of the places where the average yield of all named varieties was compared with the yield of local seed.

574. The Investigation of the Accuracy of comparing Means in the Experiment with a Scattered Situation of Replications. By N. F. Derevitzky. (*Bull. Appl. Bot. Leningrad*, 1932, Ser. 2 (3), p. 139. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 171.) The paper describes the methods of statistical analysis suited to the working out of trials consisting of a number of varieties arranged with replication in long narrow strips. The method is

that familiar under the name "randomized blocks," except that the varieties are not randomized. The author goes on to show that variation within the block due to a soil gradient may in many cases be allowed for by a modification of the analysis, in which regression coefficients are calculated for each block, and the deviation of the actual from the calculated yield is used to furnish a basis for experimental error. The mathematics of the least square solution is described.

575. The Analysis of Replicated Experiments when the Field Results are Incomplete. By F. Yates. (*Emp. J. of Exp. Agr.*, i., **2**, 1933, p. 129.) *Summary.*—The procedure introduced by Miss Allan and Dr. Wishart for supplying a missing value in a table of experimental results, such as the plot yields of a field trial, so that the treatment means form unbiassed and efficient estimates of the treatment effects, is here extended to enable any number of missing values to be replaced, it being shown that the method of derivation adopted previously is equivalent to the simpler method of minimizing the error term in the ordinary analysis of variance. The solution of a complex example is effected by iterative methods.

The validity of analysis of variance on the completed table of values is investigated. It is shown that when the degrees of freedom allotted to error are reduced by the number of values replaced, there is little disturbance, provided that the number of missing values is not too great. Such disturbance as there is always exaggerates the significance of the results. The standard errors of the treatment means are also briefly discussed.

The use of the missing-plot technique for further analysing interactions, whose significance is believed to be due to a few anomalous values, is illustrated by the analysis of a set of varietal trials on cotton.

576. Handbook of the Analysis of Plant Material, I-III. Edited by G. Klein. (Julius Springer, Wien, Vol. I., 1931, Vols. II. and III., 1932. Abstr. from *Exp. Sta. Rec.*, 68, **6**, 1933, p. 729.) Vol. I. deals with general chemical and physical methods, and the treatment and proximate analysis of plant material. Inorganic substances are dealt with in Vol. II., and organic substances in Vols. II. and III. An appendix on the analysis of lignin appears in Vol. III., Part II.

577. An Introduction to Plant Physiology. By W. O. James. (Clar. . Oxford, 1933. Price 2s. 6d. Abstr. from *Trop. Agr.*, x., **6**, 1933, p. 178.) This book is written to senior school or junior university standard, and seeks to give a balanced account of the more elementary aspects of the subject. The chapter headings include: Material and Energy; Sugars and Plant Materials formed from them; Nitrogenous Compounds; Decomposition of Sugars; The Protoplast; Water; Irritability; Growth. There are many clear diagrams, and a section dealing with experimental work concludes each chapter.

578. Plant Sociology: The Study of Plant Communities. By Dr. J. Braun-Blanquet. Translated, revised, and edited by G. D. Fuller and H. S. Conrad. (McGraw-Hill Publ. Co., Ltd., London. 1933. Price 27s.) The various sections deal with the following: The Basis of Social Life among Plants; The Organisation of Plant Communities; Synecology or Community Economics; Syngenetics; Systematics of Phytosociology.

579. Development and Shedding of Leaves of Cotton. By M. Afzal. (*Ind. J. Agr. Sci.*, iii., **1**, 1933, p. 97.) The development and shedding of leaves of four varieties of Indian cotton—Early Strain, 4F, 289F, and Mollisoni—have been studied, and the results are expressed in diagrams and tables. The ages of the cotyledons were significantly different in the various cottons. The appear-

ance of the successive leaves on the main stem was affected by the prevailing temperature, but there was no correlation between the intervals in the appearance of successive leaves on the main stem and the length of the internodes. The age of leaves at the time of shedding varied considerably during the course of the season.

580. Physiological Factors affecting the Fruiting of Cotton with Special Reference to Boll Shedding. By R. S. Hawkins *et al.* (*Tech. Bull. No.* 46, Univ. of Arizona Agr. Exp. Sta., 1933.) *Summary.*—The osmotic pressure and specific conductivity of the leaf sap and the carbohydrate content of the stems were usually inversely correlated with the available soil moisture. On certain occasions, however, other factors modifying the transpiration rate affected these plant properties more than did soil-moisture conditions. The amount of available soil moisture, through its influence on food conditions within the plants, is a major factor in regulating the fruiting behaviour of cotton plants. Relatively high osmotic pressures of the leaf sap were almost invariably followed by low percentages of shedding of the bolls, the flowers of which opened simultaneously with the occurrence of the high osmotic pressures. Extremely high osmotic pressures induced by severe reductions in soil moisture were also followed by high shedding. Low osmotic pressures were practically always followed by increased shedding. The curves representing the specific conductivity of the leaf sap parallel the osmotic-pressure curves with exceptional consistency. The percentages of carbohydrates in the stems are fairly closely correlated with the osmotic pressures of the leaf sap. The interrelation of osmotic pressure and specific conductivity of the leaf sap, and the carbohydrate content of the stems, and the close inverse correlation of these three properties with shedding, furnish further evidence that the percentage of shedding is regulated by the amount of plant food available for the development of the young bolls. Cambial activity was directly correlated with available soil moisture. Rapid vegetative growth, as expressed through the formation of large, thin-walled cells in the secondary tissues of the stems, was accompanied in a general way by increased shedding of the bolls, probably owing to the lack of sufficient plant food for vegetative and fruiting requirements. Extremely slow vegetative growth, induced by lack of soil moisture following a period of normal growth, was accompanied by relatively inactive cambium, the formation of small cells, the thickening of the cell walls of the young cells, increased carbohydrate content of the stems, lower nitrogen content, and intense shedding. The total amount of pith and of cortical tissues did not change materially from July 14 to October 1, irrespectively of soil-moisture conditions. The area of xylem in cross-sections of the stems of plants well supplied with water was considerably greater than in plants growing with limited soil moisture. The expansion in the amount of phloem was also stimulated by increased soil moisture, although to a lesser extent than was the xylem. The resumption of increased vegetative growth, as indicated by accelerated cambial activity, following the termination of periods of water deficit of varying intensities, was of approximately equal proportions irrespective of the state of cambial activity during the periods of water deficit. Periods of water shortage, initiated after the flowering season was well started, reduced the length of the flowering period in proportion to the intensity of the water deficit. The first bolls opened on all plots at about the same dates, August 18 and 19, irrespective of soil-moisture differences.

581. Mechanization of Cotton Production. By H. P. Smith. (*Agr. Eng.*, xii., 6, 1931, p. 244. Abstr. from *Circ. No.* 61, p. 25, 1931. A. and M. Coll. Texas Div. of Pubns.) A brief summary of the mechanical devices used in the production of the cotton crop, which includes the disposal of the stalks, prepara-

tion of the seed bed, distribution of fertilizer, planting and thinning of the plants, cultivation, insect control, harvesting, and ginning.

582. Cotton Gins, Cotton Pickers, Cultivators, and Rakes. By H. P. Smith. (*National Encyclopædia*, 1932, **3**, pp. 296, 298, 355. Abstr. from *Circ. No.* 68, 1932, p. 22. A. and M. Coll. Texas Div. of Pubns.) The method of removing the lint from the seed in the process of ginning is described; the various types of cotton harvesters, cultivators, and rakes are enumerated.

DISEASES, PESTS, AND INJURIES, AND THEIR CONTROL.

583. La Désinfection des Graines de Coton. By Mme. D. Soyer. (*Bull. Agr. du Congo Belge*, xxiii., **4**, 1932, p. 399.) A useful summary of the different methods of disinfection, whether (i.) physical (heat, sun, delinting, and sorting), or (ii.) chemical (immersion, dusting, and fumigation). Some good illustrations are included of the various machines in use.

584. Preliminary Trials with a Combined Insecticide and Fungicide. By H. R. Briton-Jones. (*Trop. Agr.*, x., **3**, 1933, p. 80.) An account of the operation of a new combined insecticide and fungicide evolved by the author as the result of investigations of various materials. The name of the new compound is Sulphemulsol, and it appears to be very effective, while doing little or no damage to the plants. Steeping in a 2 per cent. solution for one minute and drying has been tested for its effect on germination of several kinds of seed, including *Gossypium* spp., and in no case did the treatment adversely affect germination of the treated seed as compared with untreated.

In *Trop. Agr.*, x., **8**, 1933, p. 221, it is stated that Sulphemulsol is now being manufactured by Messrs. Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad. It is being made on a considerable scale in a specially built plant, and has been shipped to various parts of the world for use on many different types of cultivation. Supplies are obtainable from the manufacturers in free steel drums of 60 gallons capacity at 1s. 3d. per gallon, or in cases of 8 gallons at 13s. 1d. per case, which includes cost of the containers, both f.o.b. Trinidad.

585. Arsenical Fungicides and Insecticides. Grasselli Chemical Company (Cleveland, Ohio, U.S.A.). (E.P. 390,521 of 1/10/31. Abstr. from *Summ. of Curr. Lit.*, xiii., **10**, 1933, p. 258.) A combined fungicidal and insecticidal composition for application in dust form consists of finely-divided sulphur and manganese arsenate. The manganese arsenate is preferably one of low water-soluble As_2O_5 content, which may be prepared by interaction of manganese dioxide with arsenious acid, under a steam pressure of about 80 lb. per square inch, and subsequently treating the product with an alkaline agent, the arsenate of which is difficultly soluble in water. A composition containing about 90 per cent. of finely-divided sulphur and about 10 per cent. of finely ground manganese arsenate gives excellent control of fungous diseases under ordinary conditions. Dusts containing increased amounts of manganese arsenate will be beneficial on fields heavily infested with insects. It is advantageous to add to the compositions a small amount—*e.g.*, up to 5 per cent.—of aluminium hydroxide or zinc hydroxide, or a substance giving rise to the same under the conditions of application.

586. Bestuiven en Bestuivers (Dusting and Dusting Apparatus). By N. Van Poeteren. (*Versl. en Meded. Plantenz. Dienst te Wageningen*, 67, 1932. Abstr. from *Rev. App. Mycol.*, xii., **5**, 1933, p. 304.) A brief account of the history of dusting for insecticidal and fungicidal purposes is followed by a discussion of the merits of this process as compared with spraying; notes on insecticidal, fungicidal, and combined dusts; the various types of apparatus in current

use; the risks of injury to plants and the dangers to man and livestock arising from dusting; and the applicability of this form of treatment to various pests and diseases. The use of a good dusting machine, preferably of the motor type, is essential to success. The various methods of dusting and types of apparatus are clearly illustrated by 26 very good photographs.

587. Trap Collections of Insects in Cotton in 1932. By J. C. Gaines. (*Bull. Brooklyn Ent. Soc.*, xxviii., 2, New York, 1933. Abstr. from *Rev. App. Ent.*, Ser. A., 5, 1933, p. 258.) In Texas in 1932 insect injury to cotton occurred throughout the whole season. Early in the spring the seedlings were attacked by thrips, and in June and July Rhynchota—of which *Psallus seriatus*, Reut., and *Adelphocoris rapidus*, Say, were the most important—became abundant, causing an excessive shedding of squares. *Heliothis obsoleta*, F., and *Alabama argillacea*, Hb., attacked both the fruit and foliage during July and August, and *Anthonomus grandis*, Boh., which was numerous in early September, infested practically all the squares. A list is given of 199 species representing 61 families, of insects trapped in a cotton field during the period from mid-June to the end of August. The trap consisted of two pieces of screen wire tacked to frames, which were nailed together to form a right angle, and attached to three poles fixed in the ground in a triangle, so that the bottom edges of the frames were about 3 feet above the ground. The wire was thickly coated at regular intervals with an adhesive.

588. Southern Rhodesia. *Cotton Pests*, 1932. (*Rhod. Agr. J.*, xxx., 7, 1933, p. 564.) The Chief Entomologist, Mr. R. W. Jack, reports the following concerning cotton pests: "Cotton bollworm (*Heliothis obsoleta*) damaged crops to the usual extent, especially in the early setting varieties. The Sudan bollworm (*Diparopsis castanea*), a less important pest, caused considerable damage early in January. Stainers (*Dysdercus nigrofaciatus*, Stal., and *D. intermedius*, Dist.) were very abundant. The Dusky Cotton Stainer (*Oxycarenus* sp.) was very abundant on half-open bolls."

589. India. We have received the following notice from the Publicity Officer, Indian Central Cotton Committee:

The Pink Bollworm Scheme in the Punjab.—In recent years the pink bollworm has become as notorious as the boll weevil, but as the result of research it may soon be possible to forecast outbreaks of the pest and to employ control measures which will be instrumental in avoiding the immense losses to cultivators not only in India but in other cotton-growing countries. The Punjab Entomological Scheme, under which the work in connection with pink bollworm has been carried out, was started in 1926. Such good progress was made in the first five years that in 1930 the scheme was renewed for a further two years to enable the investigations to be completed. As a result of the study it has been definitely established that the procreative functions of the pink bollworm are governed entirely by climatic conditions. Experiments are under way to discover the conditions of temperature and humidity under which the moth can be compelled to emerge from the seeds before the cotton season, and its progeny destroyed through lack of food, and if these are successful it should be possible to bring the pest under complete control.

590. Pink Bollworm: Control in Italian Somaliland. By A. Chiaromonte. (*Coton et Cult. Cotonnière*, 7, 1933, p. 163. Abstr. from *Summ. of Curr. Lit.*, xiii., 12, 1933, p. 303.) It has been suggested that solar heat be employed in Italian Somaliland for freeing cotton seeds from the larvæ and pupæ of the pink bollworm. In the Simon machine for this purpose the seeds are laid out on sheets of metal which absorb the solar heat and transmit it to the seeds. Unfortunately, however, the larvæ pupate in the loose cotton fibres or in the soil, never in the seeds.

The method is, therefore, useless, and, moreover, the great heat engendered is harmful to the germinating power of the seeds.

591. Larval Instars and Feeding of the Black Cutworm (*Agrostis ypsilon*, Rott.). By A. F. Satterthwait. (*J. Agr. Res.*, xlvii., 6, 1933, p. 517.) There are three generations a year of the black cutworm at Webster Groves, Montana. Unseasonably cool weather may greatly retard larval development in the first instar, and probably serve to increase the mortality rate in later stages of these larvæ. The growth of larvæ in general, judged by head measurements, is approximate to one and a half times the size of the preceding head width, if the growth is completed in six instars. Where more instars occur, the increase after the sixth is greatly reduced for the subsequent stages. The quantities of food eaten in the first three instars are small, then increase rapidly, especially between the fifth and sixth instars, in individuals maturing in six instars. The measurement of food eaten was possible when corn foliage alone was supplied. In nature, the larvæ bite off and then discard entire plants, thus getting an unknown volume of plant tissue and wasting perhaps a thousand times more than they consume. When fed corn foliage exclusively, a larva which undergoes six instars will eat the equivalent of 65 square inches of corn leaf. The feeding of the larvæ which eventually yield females is appreciably heavier than that of larvæ which yield males.

592. Notes on the Genus *Dysdercus* (Hemiptera-Heteroptera) in Trinidad. By E. O. Pearson. (*Psyche*, xxxix., 4, 1932, Cambs., Mass. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, 7, 1933, p. 356.) Descriptions are given of the four species of *Dysdercus* (cotton stainers) found in Trinidad, with notes on their distribution and synonymy. *D. howardi*, Ballou, and *D. maurus*, Dist. (*howardi* var. *minor*, Ballou), feed and breed in Trinidad on *Eriodendron anfractuosum*, *Hibiscus cannabinus*, *H. sabdariffa*, *Malachra capitata* and *Thespesia populnea*, as well as on all varieties of cotton. *D. mimus*, Say (*albidiventris*, Stal), occurs on the same plants, and also on *Sida* spp. The food plants of *D. fernaldi*, Ballou, in Trinidad are not known to the author.

593. The Effects of Absence of Humidity on the Eggs of *Dysdercus* spp. in the Field. By A. M. Altson. (*The Entomologist's Monthly Mag.*, London, 1933, vol. lxix, no. 827, p. 83. From *Int. Rev. of Agr.*, Rome, xxiv., 5. 1933, p. M 111.)

594. Three Species of *Empoasca* Leafhoppers Known to Affect Economic Plants in Haiti (including the Description of Two New Species). By D. M. DeLong. (*J. Dpt. Agr. Puerto Rico*, xvi., 2, 1932. Abstr. from *Rev. App. Ent.*, Ser. A, 6, 1933, p. 273.) Descriptions are given of *Empoasca fabalis*, DeLong, *E. gossypii* sp.n., from cotton, and *E. canavalia* sp.n. from *Canavalia ensiformis*, in Haiti.

595. Nematodes and Cotton "Soreshin." By C. H. Arndt and J. R. Christie. (*S. Car. Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, lxviii., 6, 1933, p. 772.) A report is given of studies in co-operation with the U.S. Dept. of Agriculture.

596. The Problem of the Locust. (*Trop. Agriculturist*, lxxx., 6, 1933, p. 374.) A discussion of the "phase" theory, and also of measures of control—mechanical, chemical, and biological.

597. Phases in South African Locusts. By B. P. Uvarov. (*Nature*, London, 1933, vol. cxxxi., no. 3308, p. 423. Abstr. from *Int. Rev. of Agr.*, Rome, xxiv., 5, 1933, p. M119.) Deals with *Locustana pardalina*, *Locusta migratoria migratorioides*, *Schistocerca gregaria*, and *Nomadacris septemfasciata*.

598. Les Invasions de Criquets Migrateurs dans la Province Orientale (Belgian Congo). By J. M. Vrydagh. (*Bull. Agric. Congo belge*, xxiii., 2, 1933

Abstr. from *Rev. App. Ent.*, xxi., Ser. A, 4, 1933, p. 155.) The locust invasion that commenced in 1928 is described in detail and illustrated by sketch-maps. Swarms of *Schistocerca gregaria* appeared in 1928 and 1929; *Locusta migratoria migratorioides* invaded the country in 1930 and 1931, and in May 1931 swarms of *Nomadacris septemfasciata* made their appearance.

599. The Desert Locust, *Schistocerca gregaria* Forsk., in Egypt. By E. Ballard *et al.* (*Tech. and Sci. Serv. Bull. No.* 110, Plant Prot. Sect. Min. of Agr., Egypt, 1932. Pubd. Govt. Press, Cairo. Price P.T. 10.) A well illustrated paper, Part I. of which deals with the locust invasion in Egypt, 1927-1930, and Part II. with the life history of the pest and control measures. The account was prepared during March and April 1931, and a good deal of later information has been accumulated, which it is hoped to publish in another bulletin.

600. The Desert Locust, *Schistocerca gregaria*, Forsk., in Persia. By S. Predtechenskii. (In Russian.) (*Sborn. Vizra.*, 4, 1932, p. 72. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, 4, 1933, p. 159.) An account of investigations carried out in Persia during 1930 and 1931, with a view to discovering the conditions regulating the spring migrations of this locust, from which it would be possible to forecast the invasions of the Russian territories.

601. Southern Rhodesia. *Locust Position, April*, 1933. (*Rhod. Agr. J.*, xxx., 5, 1933, p. 351.) The present locust position is the worst that has ever been experienced. As far as hoppers are concerned, it is much more serious than that of the Brown Locust invasion in 1924; a greater area of the country is involved, and the density of the swarms is also greater. In the present campaign sufficient poison has been issued to date to make 5,000,000 gallons of spray. The estimated cost of the campaign is about £10,000, and owing to the splendid assistance rendered by the farmers the results obtained from this expenditure compare very favourably with those secured in previous locust campaigns in any part of Africa.

602. Locusts: Instruction for Dealing with Flying Swarms. (*Rhod. Agr. J.*, xxx., 5, 1933, p. 399.) Smoke screens, produced by injecting waste oil into the exhaust box of an internal combustion engine, are recommended for keeping locusts from crops. This method has the advantage of delivering a continuous curtain of smoke, and can be applied on the most suitable line according to the direction of the wind at the time. The following formula for a chemical smudge is also recommended: Saltpetre (30 parts), sulphur (12), borax (8), coal tar (25 parts). A deep tin should be filled three-quarters full of the tar mixture, and on top should be placed a ¼-inch layer of priming mixture composed of saltpetre, sulphur and borax (2 parts), and fine white sugar (1 part). A pound tin of this mixture will burn for 12 minutes. Another recommended formula is the following: Five-gallon drum coal tar; 100-lb. bag of nitrate of soda; 50 lb. sulphur; 25 lb. borax. This quantity is sufficient to fill 100 one-pound tins, and each tin should burn for 15 minutes.

603. Description of Hopper Instars of the Red Locust *Nomadacris septemfasciata*, Serv., Phase Gregaria, and some Changes in Adult Colouration. By M. C. Mossop. (*Proc. of the Rhod. Sci. Assoc.*, xxxii., May, 1933, p. 113.) The descriptions were made from fresh field specimens taken in Southern Rhodesia during February and March 1933. There were six instars during this period—viz., four with the wing rudiments on the side of the thorax, and two with the rudiments reversed in position and lying over the back. The vermiform larval instar has not been included.

604. The Tsetse Fly Problem in Southern Rhodesia. By R. W. Jack. (*Rhod. Agr. J.*, xxx., 5, 1933, pp. 365 and 393.) The first paper contains a very

interesting account of the tsetse fly problem and what is being done to hold the pest in check in Southern Rhodesia. A map is included showing the distribution of *Glossina morsitans* in the Colony. The second paper by the same author deals with the use of traps for this species of tsetse fly.

605. MICROBES AND ULTRAMICROBES. By A. D. Gardner. (Methuen and Co., Ltd., London. Price 3s. 6d. Abstr. from *Trop. Agr.*, x., 6, 1933, p. 178.) For students, this book is an excellent introduction to bacteriology, giving a skeleton around which the more complicated body of the subject may be built. Part I. deals with bacteria and their variation, including a short explanation of the different generic names as well as a detailed discussion of the occurrence of Rough and Smooth forms; Part II. summarizes our present knowledge of the viruses and their relation to immunity; and Part III. is devoted to the bacteriophage phenomena. A glossary is appended in order to avoid laborious explanations of terms used throughout the text.

606. COTTON DISEASE RESEARCH. (*Ann. Rpt. of Empire Marketing Board*, 1932-1933.) "The work at the Rothamsted Experimental Station on the Angular Leafspot or Blackarm disease of cotton, which has been assisted for four years by the Empire Marketing Board, has been brought to a conclusion on the departure of Dr. Stoughton from Rothamsted.

"The work on the influence of environmental conditions on the disease, which has been carried out in the special control chambers erected under a grant from the Board, has led to a number of definite conclusions. The results of six years' work on this aspect of the disease may be briefly summarized:

"Primary infection of the cotyledon is usually due to bacteria carried on the outside of the seed and in the fuzz. Thorough disinfection of the exterior of the seed results in healthy seedlings.

"Soil temperature affects the amount of primary infection, a constant soil temperature above 30° C. reducing the degree of infection, but infection is not inhibited at 40° C. A regular diurnal variation in soil temperature produces the same effect on infection as a constant temperature near to the mean of the fluctuations. Soil temperature is of importance as regards the disease only during the first two or three days after sowing. A high soil moisture content favours the primary infection. Primary infection is affected by the type of soil in which the plants are grown. Soil temperature has little or no effect on secondary infection resulting from spray inoculation of the plants. Plants diseased in the seedling stage grow out free from disease if no further inoculation occurs.

"Air temperature has a marked effect on secondary infection. Maximum infection occurs at a constant air temperature of 35 to 38° C., with decreasing incidence at progressively lower temperature. A regular diurnal variation in air temperature exerts an effect on the amount of disease equivalent to that of a constant near to the mean of the fluctuations. Experiments on abrupt changes of temperature show that air temperature is of importance throughout the incubation period of the disease; the actual temperature at the time of inoculation is comparatively unimportant, except in so far as it affects the mean temperature during the incubation period. The amount of infection at a given temperature, or mean equivalent temperature, is conditioned by the atmospheric humidity at the time of inoculation. High humidities favour infection, low humidities reduce it. Humidity is of importance only during the first two days after inoculation."

607. PLANT DISEASE AND ENVIRONMENT IN SOUTHERN RHODESIA. By J. C. F. Hopkins. (*Trop. Agr.*, x., 6, 1933, p. 172.) In regard to cotton diseases the author writes: "Diseases of cotton appear to be very largely controlled by

the climatic conditions prevailing in the Colony. . . . Generally speaking, the crop receives good rains and warm temperatures for a few months, after which the rains cease relatively suddenly and temperatures drop considerably. Such conditions favour the development of fungus and bacterial diseases in the early part of the season, so that angular spot (*Bacterium malvacearum*) and fungus leaf spots are commonly present. Before these can cause any really serious damage, however, climatic conditions unfavourable to their development intervene, and the diseases are arrested. Thus the serious 'blackarm' is not encountered, and the amount of internal boll disease (*Nematospora coryli*) is not as a rule proportionate to the number of 'stainers' found in the cotton fields. Similarly, boll rots due to *B. malvacearum* and *Rhizopus stolonifer* do not develop to the same extent as in more humid countries, and other boll rots are rare; root diseases due to fungi are unknown. It therefore appears that diseases of cotton in Southern Rhodesia are controlled at present solely by climatic factors."

608. UGANDA. *Field Experiment on Blackarm Disease of Cotton.* By C. G. Hansford. (*Ann. Rpt. Dpt. of Agr. Uganda*, 1931, pt. ii., p. 61.) A preliminary account of an experiment carried out at Kampala to obtain some data capable of statistical examination, on the behaviour of blackarm disease under Uganda conditions. Sixteen plots, each of 121 cotton plants, were sown with seed (A) untreated, (B) immersed for 15 minutes in a diluted culture of *B. malvacearum*, (C) delinted in sulphuric acid for 35 minutes, washed, then immersed in dilute corrosive sublimate solution for 30 minutes under a vacuum pump, and finally washed, (D) dusted with Dupont granosan. Each treatment was applied to four sub-plots, and records were made of the crop produced by each plant. A preliminary analysis of the results indicated that estimating the amount of infection per plot by multiplying the number of infected plants by the number of days each was infected, there was significantly more infection on the "inoculated" plots (B), and less on the "delinted" plots (C) than on either the controls (A) or the "dusted" plots (D). The disease spread from the plants showing primary infection to the surrounding plants at a fairly slow and even rate until a rapid rise in the middle of October. The spread then slowed down until it rose to a second peak in the second and third weeks of December. The direction of spread of the disease was closely similar to that of the flow of surface water during heavy rain; the only healthy plot remaining at the close of the experiment received no rain-wash from other plots of cotton. The stem form of the disease showed a steady rise in all the plots until December 9-21, when it rose rapidly in all the plots except the healthy one. The greater part of infection on the stem and branches originates in the leaves, and extends down the tissues of the petioles.

609. *Rhizoctonia lamellifera*, SMALL; A DISTINCT SPECIES OF THE *Rhizoctonia bataticola* GROUP OF FUNGI. By J. C. F. Hopkins. (*Proc. of Rhod. Sci. Assoc.*, xxxii., May, 1933.) *Summary.*—A comparative study has been made of fungi of the *Rhizoctonia bataticola* group, falling within the limits of Haigh's A and C strains. A number of isolations of the two fungi have been studied in culture, and certain distinctive characters of mycelium and sclerotium are described. What are considered to be specific differences between the A group and the C group (of Haigh) are indicated. It is proposed to re-establish Small's species, *Rhizoctonia lamellifera*, for fungi of the A group. [*Cf.* Abstr. Nos. **116**, **299**, **300**, Vol. V., and **378**, Vol. VII., of this REVIEW.)

610. REPORT OF THE FIFTH ANNUAL COTTON ROOT-ROT CONFERENCE. By W. N. Ezekiel *et al.* (*Phytopathology*, xxii., 1932, p. 983. Abstr. from *Circ. No.* 68, p. 28, 1932, A. and M. Coll. Texas Div. of Pubns.) This report includes very brief abstracts of the 55 technical papers presented at the annual root rot conference held at Austin, Texas, in 1932. These papers included results obtained

during the preceding year in studies relating to physiologic specialization of *Phymatotrichum omnivorum*, growth and nutrition of the fungus, sclerotial and spore stages, host plants, infection and resistance, hibernation and transmission of root rot, occurrence of root rot and estimation of losses; and studies bearing directly on control of the disease from the aspects of soil conditions, including soil reaction, fertilizer applications, soil disinfectants, barriers to limit spread of root rot, subsoiling, rotation, and resistant species and varieties.

611. PLANT PATHOLOGY. By J. G. Brown. (*43rd. Ann. Rpt. Arizona Agr. Exp. Sta.*, 1932. Abstr. from *Rev. App. Mycol.*, xii., **5**, 1933, p. 270.) Several strains of Acala cotton have given promising results in respect of resistance to root rot (*Phymatotrichum omnivorum*).

612. AN UNDESCRIBED SCLEROTIUM FUNGUS PREVALENT IN NORTH-EAST TEXAS. By D. C. Neal and R. E. Wester. (*Phytopath.*, xxiii., **1**, 1933, p. 24. Abstr. from *Rev. App. Mycol.*, xii., **7**, 1933, p. 439.) Decayed cotton stalks and roots a few inches below soil level at Greenville, Texas, were found, following a wet period in September, 1932, to bear white to pale yellow, ovoid or ellipsoid, smooth sclerotia, measuring 5 by 1 mm. and formed of anastomosed hyaline hyphæ; they developed on mycelial strands similar to those of *Phymatotrichum omnivorum*, though finer in texture, and were variously constricted and often forked at the strand connections. The mycelium is septate and branching, and certain new cells arising from the side of a parent hypha tend to grow in opposite directions. Pending further investigations, the name *Ozonium texanum* n.sp. is proposed for the fungus.

613. SCLEROTIA-FORMING HABITS OF THE COTTON ROOT-ROT FUNGUS IN TEXAS BLACKLAND SOILS. By H. C. Macnamara and D. R. Hooton. (*J. Agr. Res.*, xliv., **9**, 1933, p. 807.) In this study of the sclerotia-forming habits of the root-rot fungus (*Phymatotrichum omnivorum* [Shear.] Dug.) the soil was excavated from different depths and broken apart to reveal the sclerotia *in situ*. They were frequently found in the soil in colonies or groups around the seat of infection in a primary centre. They were not found on the taproots or on the large lateral roots of cotton plants, but out in the soil where only small rootlets occurred. Older sclerotia were found below the " plough slice " at depths of 4 to 18 inches, but usually at a depth of 4 to 12 inches. They are capable of lying quiescent for several years, so that control of root rot by clean fallows or non-susceptible crops apparently will need to be supplemented by tillage operations that will reach the sclerotia. Sclerotia would appear to be connected primarily with the saprophytic phase of the fungus and serve as a resting stage.

614. ADMINISTRATION REPORT OF THE MYCOLOGIST, MADRAS, FOR THE YEAR 1931-32. By S. Sundararaman. (*Rev. App. Mycol.*, xii., **5**, 1933, p. 266.) Seedling blight (*Colletotrichum*) of Uppam cotton was controlled by the use of healthy seed, spraying twice in the seedling stage, wider spacing in sowing, and removing the secondary hosts, *Aristolochia bracteata* and *Hibiscus ficulneus* (*H. diversifolius*). Saltation yielded four additional strains of the fungus, and generally occurred in alkaline media (up to pH8) where the depth of the medium was shallow. Infection was favoured by a soil moisture range of 37·5 to 50 per cent. of the water-holding capacity of the soil.

615. A NOTE ON THE VARIATION OF PERCENTAGE INFECTION OF WILT DISEASE IN COTTON. By P. C. Mahalanobis and S. S. Bose. (*Ind. J. Agr. Sci.*, ii., **6**, 1932, p. 704.) A statistical analysis of data on the relation between sowing date and the severity of infection shows that wilt infection is far more severe on plants sown in June than on plants sown in July or August.

616. COTTON RUST AND WILT· CONTROL WITH POTASH. By H. T. Maddux. (*Com. Fertilizer*, i., **46**, 1933, p. 14. Abstr. from *Summ. of Curr. Lit.*, xiii., **11**,

1933, p. 275.) In 587 top-dressing experiments carried out over a period of five years, application of 50 to 100 lb. of potassium chloride in addition to the regular application of complete fertilizer gave an average increase of 147 lb. of seed cotton per acre per year, incidence of rust being greatly reduced by the extra potash. In sandy alluvial soils, fertilizers containing potash were very effective in reducing cotton-wilt infection and increasing yields.

617. Über die Bildung von Toxinen Durch Verschiedene Pflanzenparasiten (On the Formation of Toxins by Various Plant Parasites). By E. Schaffnit and M. Ludtke. (*Ber. Deutsch. Bot. Gesellsch.*, i., **9**, 1932, p. 444. Abstr. from *Rev. App. Mycol.*, xii., **5**, 1933, p. 314.) An account is given of the writers' investigations on the chemical nature and effects of the toxins secreted by *Ophiobolus graminis*, *Fusarium vasinfectum*, *F. lycopersici*, and *Didymella lycopersici*.

Cotton and tomato plants were injured or killed by the filtrates of cultures of *F. vasinfectum* and *F. lycopersici*, respectively, on Richards' solution, the optimum temperature for the development of the former of which was found to be 24° to 28° C. Wilting of cotton began after 28 hours in the filtrate of a week-old culture of *F. vasinfectum*, the corresponding period for tomato in the *F. lycopersici* filtrate being 24 hours; at, and after, five weeks old the culture filtrates were capable of destroying the plants in a few hours (seven at the most). The pH value of the culture fluid at five weeks had risen from an initial of 4·02 to 7·41 in the case of *F. vasinfectum*, and to 7·84 in that of *F. lycopersici*. The toxic principle was found to be virtually restricted to the residue on distillation. Lathrop's assumption that the presence in the filtrate of propionaldehyde is the cause of wilting could not be verified by the writers.

A strongly toxic action was exerted on the test plants by the extract from centrifuged ground hyphæ of *F. vasinfectum*, indicating that the poison is an organic substance residing in and excreted by the fungus, and not a product of the nitrites or other salts of the culture liquid. Not only cut tomato plants, but those with intact roots, contrary to Bewley's observations, were wilted by a 0·5 per cent. solution of the toxin, which lost none of its virulence by 20 minutes' boiling. In all probability the toxic substance is an amine or combination of amines. Both the culture filtrate and the mycelial extract of *F. vasinfectum* caused wilting of clover, peas, chrysanthemum, cotton, beans, and wheat in addition to tomato. Cotton, pea, and wheat seeds laid (after sterilization and washing) between sheets of blotting-paper, moistened with the toxic solution, suffered retardation of germination.

618. Actions des Rayons Solaires sur les Spores de Bacteries Pathogénes pour les Insectes. By S. S. Metalnikov, jun. (*C. R. Soc. Biol.*, cxii., **16**, Paris, 1933, p. 1666. Abstr. from *Rev. App. Ent.*, xxi., Ser. A., **7**, 1933, p. 364.) The dry spores of bacteria pathogenic to *Pyrausta nubilalis*, Hb., preserve their vitality for months, if not years. Experiments were conducted in Egypt to test whether dry spores remained pathogenic to *Platyedra gossypiella*, Saund., after long exposure to strong sunlight. Spores of *Bacterium cazaubon*, isolated from *P. nubilalis*, and, in earlier experiments, of *B. ephestiæ*, No. 1, isolated from *Ephestia kuhniella*, Zell., in Egypt in 1931 were exposed continuously to direct sunlight in petri dishes, open or having a glass cover raised at the edge for ventilation, for periods of 4 and 10 days, between June 4 and 26, when the temperature ranged from 14° C. (57·2° F.) to 56° C. (132·8° F.), with a mean of 27° C. (80·6° F.), and for periods of 6 and 20 days between September 20 and October 10, with a range of 18° C. (64·4° F.) to 40° C. (104° F.), and a mean of 23° C. (73·4° F.). To test the pathogenicity of the spores a suspension was prepared containing 15 mg. in 1 c.c. of water. Healthy larvæ of *P. gossypiella* were placed on cotton sprayed

with about 0·6 c.c. of this emulsion, and injections of 0·01 to 0·02 c.c. were made into others. All the injections were fatal, but the interval before death for *B. cazaubon* was prolonged from 3-4 hours to 14 hours by the 10 days' exposure, and to 9½ hours by the 20 days' exposure, and for *B. ephestiæ* from 2 to 8 hours by the 10 days' exposure. The interval before death by ingestion was prolonged from 18 to 23 and 21 hours in the corresponding experiments with *B. cazaubon*, after which, of 10 larvæ, 1 and 5 respectively survived. In the experiment with *B. ephestiæ* the interval was prolonged from about 7 to 27 hours, none of the larvæ surviving. The results of the shorter exposures to sunlight showed that the reduction in the pathogenicity of the bacteria was progressive, but so long as the spores remain dry, it is obviously very slow. It was more marked when the dish was covered.

[*Cf.* Abstr. **581**, Vol. IX., of this REVIEW.]

619. UTILIZATION DES BACTÈRIES DANS LA LUTTE CONTRE LES INSECTES NUISIBLES AUX COTONNIERS. By S. Metalnikov and S. S. Metalnikov, jun. (*C. R. Soc. Biol.*, cxiii., **18**, Paris, 1933, p. 169. Abstr. from *Rev. App. Ent.*, xxi., Ser. A., **7**, 1933, p. 365.) Following laboratory tests (see preceding abstract) with bacteria pathogenic to *Platyedra gossypiella*, Saund., experiments were carried out in a severely infested cotton field near Cairo from July 1 to October 30, 1932. The bacteria used were *Bacterium ephestiæ* from *Ephestia kühniella*, Zell., *B. gelechiæ*, No. 5, isolated from dead larvæ of *P. gossypiella*, and *B. cazaubon*. The dry spores in powder form were mixed with water at the rate of 1 to 4 oz. to 2½ gallons, with the addition of 4 per cent. of molasses, and sprayed on the plants two or four times at regular intervals at the rate of 196 gallons or less to the acre. The best results were obtained in plots treated with *B. ephestiæ*, the infestation in them being reduced by about 50 per cent., as compared with the controls. A slightly smaller reduction occurred in plots sprayed with *B. cazaubon*, whereas *B. gelechiæ* reduced the infestation by rather less than 40 per cent. Plots treated with an arsenical spray showed a reduction of only 18 per cent. Counts of the infested bolls and the estimation of the weight of harvested cotton and seeds, details of which are shown in a table, also gave data considerably in favour of *B. ephestiæ*. Some evidence was obtained of a spread of the bacterial infection beyond the treated area.

GENERAL BOTANY, BREEDING, ETC.

620. SCIENCE OF THE YEAR, 1932: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (Reprint received from the author, 1933.) A useful and informative summary of the work carried out during the year, and the important results obtained, in connection with Evolution and Genetics, Zoology, General Physiology, Botany, Microbiology, and Disease.

621. BREEDING VARIETIES OF COTTON TO MEET THE NEEDS OF MECHANICAL HARVESTING. By D. T. Killough. (*The Valley Farmer*, v., **9**, 1932. Abstr. from *Circ. No.* 68, 1932, p. 26, A. and M. Coll. Texas Div. of Pubns.) In studying the problems in connection with the mechanical harvesting of cotton, tests were conducted to determine the adaptability of a number of the more commonly grown varieties of cotton to harvesting by machinery. Certain difficulties were encountered in harvesting, due largely to the spreading vegetative growth and indeterminate fruiting habits of these varieties. The need was evident from these studies for a variety of cotton that, in addition to yielding well, would have an early and short fruiting period, would have large storm-resistant bolls, and a minimum of vegetative growth, in order that the cotton could be readily harvested from the plants by machinery with a minimum of loss, and early enough in the

season to escape damage by unfavourable weather conditions generally existing later in the fall. The breeding work, conducted over a period of five years in developing a variety through hybridization having the characteristics mentioned, is described. In harvesting trials with the new variety, the machine was able to harvest a higher percentage of cotton from the plants, with less trash to lower the grade, than was possible with the other commonly grown varieties tested.

622. Interspecific Hybridization within the Limits of the Cotton Plant Varieties with Different Chromosomes. By S. S. Kanash. (*Proc. Cent. Asia Sci. Res. Cott. Inst.* (Sredaznikhi.) The Work of the Cent. Plant-Breeding Station, Tashkent, 1932. Translated, Imp. Bur. of Plant Genetics, Cambs. England, 1933.) *Summary.*—1. The work on distant hybridization within the genus *Gossypium* has demonstrated experimentally the possibility of crossing all the different chromosome species of cotton (the 26 with the 52 chromosome species), and that the direct and reciprocal crosses are equally successful.

2. In three years (1927 to 1929) 59 interspecific F_1 hybrids between species differing in chromosome number have been obtained by artificial crossing, namely:

G. barbadense × *G. herbaceum*	17 hybrids.
G. herbaceum × *G. barbadense*	6 ,,
G. barbadense × *G. arboreum, neglectum, Nanking* ...	6 ,,
G. Nanking × *G. barbadense*	1 hybrid.
G. hirsutum × *G. herbaceum*	16 hybrids.
G. herbaceum × *G. hirsutum*	5 ,,
G. hirsutum × *G. arboreum*	1 hybrid.
G. arboreum, neglectum × *G. hirsutum*	7 hybrids.

The majority of the interspecific hybrids have not been described in the existing literature.

3. The percentage of F_1 hybrids varies in different years and in the same cross from 0·1 to 2·5. No particular regularity has yet been observed.

4. Interspecific F_1 hybrids from direct and reciprocal crosses are distinguished by their identity in regard to morphological characters.

5. In morphological characters the interspecific F_1 hybrids (from direct and reciprocal crosses) have somewhat intermediate character, but with a definite preponderance of dominant characters from the 52 chromosome cottons; moreover, there was a partial and in some cases complete absorption of the characters of the 26 chromosome species by those of the 52 chromosome species.

6. Heterosis development was characteristic for the interspecific F_1 hybrids. Heterosis was particularly marked in the hybrids *G. barbadense* × *G. arboreum*; heterosis was somewhat less marked in other interspecific hybrids with the exception of the F_1 of *G. hirsutum* × *G. arboreum, neglectum*, in which no intensification in the development has yet been observed.

7. In interspecific crosses the 26 chromosome Old World cottons displayed pronounced parthenocarpy (false development of the fruits), which is not so pronounced in the 52 chromosome species. The phenomenon of parthenocarpy is not connected in any way with better fertilization.

8. All interspecific F_1 hybrids displayed a high degree of self-sterility. As a result of reciprocal crosses of the F_1 with the parental forms (both maternal and paternal), a number of somewhat fertile plants appeared. In all back-crosses fertilization was successful when the 52 chromosome species served as pollen parent.

9. In 1928, for the first time, two partially fertile F_2 hybrids were produced from the cross *G. barbadense* × *G. arboreum*; in 1930 partially fertile hybrids (from

back-crosses) were obtained in all combinations. In all 10 partially fertile hybrids were obtained.

10. Interspecific F_1 hybrids also displayed in backcrosses very reduced fertility. In the majority of cases only one imperfectly developed fruit was obtained per plant, containing one seed; in only two F_2 hybrids from *G. barbadense* × *G. arboreum* did the number of one-seeded fruits amount to 5 and 9. The seeds developed, and were either entirely normal or very much increased in size.

11. The crosses were most successful in the latest periods (in September), which is apparently connected with the influence of the lower temperatures. Artificial reduction of temperature, chloroforming, the action of dilute solutions of cane sugar and citric acid, which were applied in crosses and self-pollinations of the interspecific hybrids, have so far been without success.

12. In 1930 two F* hybrids obtained from the backcross of the F_1 (*G. barbadense* × *G. arboreum*) with the maternal parent were examined. The first F_2 hybrid, No. 3,160, constituted an almost complete reversion to the maternal type, and displayed marked increase of fertility approaching the normal.

As a result of self-pollination and crossing with *G. barbadense* the hybrid plant F*, No. 3,160 developed 27 fruits with 216 normally developed seeds. Crosses of hybrid No. 3,160 with *G. arboreum* and other species have so far been unsuccessful. Reciprocal crosses of *G. Nanking* with the F_2 hybrid were successful, and in 1931 one plant from this cross was grown. Reciprocal crosses of *G. barbadense* × F_2, as shown by the 1931 data, gave a high percentage of developing fruits.

13. The second F* plant No. 3,159 represents a form sharply deviating from both parental species and displaying a series of new characters. In consequence of the almost complete contabescence of the anthers and the degeneration of the pollen cells, it was absolutely self-sterile, but, on the other hand, crosses comparatively well with the maternal form, which indicates the absence in the given hybrid of serious disturbances in the embryo sac mother cells. From crosses of the F* hybrid No. 3,159 with the maternal form of *G. barbadense*, 22 seeds were obtained. From backcrosses and self-pollination of hybrid No. 3,160, and from crosses of hybrid No. 3,159 (F_2 generation), 130 hybrid F_3 plants were obtained in 1931.

14. The data from the three years' work differ widely from the existing views on distant crosses between Old and New World cottons, and do not confirm these views; the capacity of the different chromosome species to cross in all directions has been experimentally demonstrated; these data also failed to confirm the general opinion as to the absolute sterility of the F_1 hybrids. On the basis of the results a critical approach can be made to all the improbable conclusions made by G. S. Zaitzev, who considered that interspecific hybridization can have no practical importance, who attempted to prove the constancy of the groups established by him, and denied the possibility of any inter-relationship between the Old and New World species of cotton.

15. The investigation of the interspecific hybrids of the F_1 and F_2 generations, and a preliminary examination of the F_3, established the following: The high degree of sterility of the first generation hybrids, and at the same time the possibility of obtaining amongst them certain partially fertile hybrids; a notable complexity of the segregation; the reversion to the parental type; and the attainment of high fertility in the F_2 generation. It also confirms the possibility of reciprocal crosses between the F_2 and the 26 chromosome cottons. In the F_3 a great variety of forms, combining the different characters, and an extremely high fertility in certain of the hybrid plants, was observed.

* Generation not indicated. (Translator's note.)

16. The material now available in interspecific hybridization reveals a new direction for future work, together with great prospects for the solution of the question of the origin of forms and species, the production of polyploid forms of cotton, and also the solution of the question of systematics and classification of the genus *Gossypium*. The great diversity of forms combining the different characters and the high fertility of the interspecific hybrids in later generations, show the possibility of their practical utilization and the exceptional possibilities thereby presented to the cotton industry.

623. A NOTE ON A CROSS OF *Gossypium Stocksii*, M. MAST, WITH *Gossypium indicum*, GAMMIE. By M. Afzal and T. Trought. (*Ind. J. Agr. Sci.*, iii., **2**, 1933, p. 334.) *Summary.—G. Stocksii*, M. Mast, has been successfully crossed with *G. indicum*, Gammie. The F_1 plants do not resemble each other, but three plants resemble very much the *Stocksii* parent in appearance, while the fourth one is intermediate. No satisfactory explanation has, so far, been found to account for the diversity among the F_1 plants. All the F_1 plants are sterile.

624. THE F_1 GENERATION OF A HYBRID BETWEEN AN AMERICAN AND AN ASIATIC COTTON. By S. J. Patel. (*Ind. J. Agr. Sci.*, iii, **1**, 1933, p. 127.) Stigmas of Bourbon cotton (*G. purpurascens*) were pollinated from Wagad 12 (*G. herbaceum*) and one flower gave a boll with a single fertile seed. The various characters from the hybrid from this seed are described. In purple leaf spot, purple colouration of branches and stem, broadness of leaves, dentation of bracteoles, position of stigma in the bud stage, the Bourbon parent was dominant. The Wagad parent was dominant in position of first sympodium on the main stem, flowering habit, number of lobes per leaf, petal colour, pollen colour. Characters intermediate between the two parents were, hairiness of stem and leaves, height, petal spot. The hybrid, although flowering profusely, was completely sterile.

625. LE *Gossypium anomalum*, WAWRA ET PEYR. EST-IL UN COTONNIER OU UN *Cienfuegosia* ? (Is *Gossypium anomalum*, Wawra et Peyr., a cotton or a *Cienfuegosia* ?) By A. Chevalier. (*Rev. Bot. Appl. Agric. Trop.*, **13**, 1933, p. 190. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 195.) From a comparison of the morphological characteristics of *Gossypium anomalum*, Wawra et Peyr., and of *Cienfuegosia digitata*, the type of the genus *Cienfuegosia*, the author concludes that *Gossypium anomalum*, Wawra et Peyr. (which later was classed as a *Cienfuegosia* by Gurke), should be regarded as a *Gossypium*. The geographical distribution of *G. anomalum* in Central and West Africa is discussed and certain morphological considerations are mentioned as evidence for the possibility that *G. anomalum* may perhaps have been the species from which certain cultivated cottons of the Old World have developed.

626. DIE GENAUE BESTIMMUNG DES ZEITPUNKTES DER MENDELSPALTUNG. (SAMMELREFERAT). [The exact determination of the stage at which Mendelian segregation occurs. (Survey of literature.)] By F. Brieger. (*Züchter*, **5**, 1933, p. 34. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 169.) It has been possible to demonstrate by diverse techniques that segregation may occur in some organisms at the first maturation division, in other organisms at the second division, and in still other organisms at either division. Moreover, segregation often depends to a considerable extent on external and internal factors. The author suggests that, apart from the great theoretical importance of these facts, they may possibly have a practical bearing on the problem of mutation or the artificial production of unreduced polyploid germ cells.

627. NEW METHODS OF PLANT-BREEDING: INDUCED POLYPLOIDY. By P. S. Hudson. (*J. Min. Agr.*, **40**, 1933, p. 21. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 158.) Emphasis is laid on the growing importance of cytology

in general in problems of practical breeding, and after a popular explanation of the principles involved, examples are given of fertile hybrids between distantly related species or different genera as a result of chromosome duplication. In continuation, attention is called to the possibility under modern experimental conditions of inducing chromosome duplication artificially, and it is suggested that wide crossing followed by induced polyploidy may in the future become a successful and rapid method of producing new hybrids, since the hybrids so formed give constant progeny.

628. Chlorophyll Deficiencies Induced in Cotton (*Gossypium hirsutum*) by Radiations. By W. R. Horlacher and D. T. Killough. (*Proc. Texas Acad. of Sci.*, Nov., 1931. Abstr. from *Circ. No.* 61, p. 27, 1931, A. and M. Coll. Texas Div. of Pubns.) Chlorophyll-deficient areas appeared frequently in the leaves of cotton plants grown from X-rayed seed. Three cases of germinal mutations to complete chlorophyll deficiency were induced. This chlorophyll-deficient seedling type has been named yellow. Yellow seedlings segregated out from three different lines of cotton—viz., homozygous red leaf cotton, homozygous green leaf cotton, and a line which was green but was heterozygous for virescent yellow. In each of the three lines yellow segregated from green as a simple Mendelian recessive. Yellow is lethal.

629. The Production of Mutations in American Upland Cotton (*Gossypium hirsutum*) by Radiations. By W. R. Horlacher and D. T. Killough. (*Proc. of 6th Ann. Cong. of Genetics*, vol. ii., August, 1932, Abstr. from *Circ. No.* 68, p. 30, 1932. A. and M. Coll. Texas Div. of Pubns.) American Upland cotton (*Gossypium hirsutum*), has been found to be susceptible to X-ray treatment. In radiating dry cotton seed variant types were produced in large numbers among the progeny grown from the X-rayed seed. These consisted of teratological forms and of types that were quite evidently due to somatic mutations. The X_2 generation, grown from selfed bolls on the X_1 plants, gave evidence that heritable changes in leaf colour and shape had been induced. Two of these are progressive mutations. Gene mutations which are inherited in Mendelian ratios in future generations were induced.

630. Critical Notes on C. D. Darlington's "Recent Advances in Cytology." By J. Belling. (A posthumous paper, with reply by C. D. Darlington.) (*Univ. Calif. Pub. Bot.*, **17**, 1933, p. 75. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 169.) A detailed criticism of a number of statements in Darlington's recent book, in which the reviewer takes exception to Darlington's free use of speculation, or rather to the failure to indicate in the text that particular views are conjectures and not facts. The terminology is also criticized and certain mis-statements and other inaccuracies pointed out.

In his reply Dr. Darlington accepts many of the criticisms whilst defending the speculative point of view.

[*Cf.* Abstr. **117**, Vol. X. of this Review.]

631. Vernalization of Lyssenko's Method for the Pre-Treatment of Seed. By R. O. Whyte and P. S. Hudson. (*Imp. Bur. of Plant Genetics, Aberystwyth and Cambs, Bull. No.* 9, 1933. Price 2s. 6d. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 157.) Lyssenko and his co-workers claim that the plant is all through its life susceptible to those influences which determine its passage from one phase to another of its vegetative cycle. Thus the influences which determine its passage to the reproductive phase can just as well be applied to a young seedling as to the older plant. This is the essence of the method, which consists in inducing the seed to start germinating and, before the seed coat is ruptured, to subject this "seed," which already constitutes the growing plant, to those con-

ditions of light, temperature, etc. (according to species and variety), which it requires in order to enable it to reproduce. After this the plant will complete its reproductive cycle regardless of whether these conditions are further supplied or not.

By the aid of the method it has been possible to bring winter wheat to maturity in northern latitudes where only spring wheat can normally be grown, and many other experiments of a similar nature are reported, including the treatment of potato tubers by continuous illumination before planting, after which tuber formation occurred in northern latitudes not normally suited to potato growing.

By combining these methods with ordinary breeding it is hoped to produce new races of plants which react in the ways described without the necessity of pre-treatment.

632. DIE JAROWISATION DES GETREIDES NACH T. D. LYSSENKO. By O. Nerling. (*Zuchter*, **5**, 1933, p. 61. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 170.) A brief account in German of some of the results referred to in the previous abstract.

FIBRE, YARN, SPINNING, WEAVING, ETC.

633. FIBRES. (*Text. Weekly*, ii., **280**, 1933, p. 500.) Under the above title, the Empire Marketing Board, Statistics and Intelligence Branch, has issued a summary of facts and figures relating to the production and trade in cotton, wool, silk, hemp, flax, and jute fibres. The book can be purchased, price 6d. net, from H.M. Stationery Office. This is a very good summary, dealing with the economic side of textile fibres in handy form in one book.

634. COTTON HAIR: STRUCTURE. By J. Atsuki and M. Ishiwara. (*J. Soc. Chem. Ind., Japan*, **36**, 1933, 221B. Abstr. from *Summ. of Curr. Lit.*, xiii., **14**, 1933, p. 368.) The minute structure of the wall of the cotton hair was investigated by means of microscopic observation of the swollen fibre and by X-ray analysis. It was observed that the so-called fibrils wind spirally up the hair in the direction of the principal axis, making an angle of 90° between the turns. The micelles lie with their main axes perpendicular to the axis of the fibril.

635. COTTON HAIR: STRUCTURE. (*Amer. Dyes Rep.*, **22**, 1933, p. 299. Abstr. from *Summ. of Curr. Lit.*, xiii., **12**, 1933, p. 314.) The author discusses Peirce's theories and some ideas derived from the work of other investigators. He points out that there is little, if any, real evidence for an inner structure consisting of separate crystallites embedded in a matrix of amorphous cellulose. Spierer photographs appear to confirm the micellar theory, but certain investigators still hold the view that the spiral elements in cotton are continuous from one end of the hair to the other, unless interrupted by accident. The lack of change in the X-ray diagram on swelling in water or other liquids seems to indicate that the liquid is taken up between concentric layers of crystallites, and does not affect the lengthwise or tangential bonds or cohesive forces. The elastic properties indicate that the lengthwise cohesive forces are virtually unaffected by moisture. On the other hand, the spirals seem to cohere radically through hydroxyl groups which are very sensitive to moisture. The properties are well accounted for by the assumption that each glucose residue contains one hydroxyl group that is mainly responsible for radical cohesion, and can hold one water molecule as "water of crystallization." The lengthwise bond is supposed to be the oxygen bridge formed by dehydration when the soluble carbohydrate condenses to the solid glucose residue (or biose) on the cellulose wall which has already formed. The next step is coherence as concentric sheets through the hydroxyl groups, as already

mentioned. The layers are laid down in the presence of water, and possibly connected first through water molecules. The glucose units do not lie flat in the cell, but at a slant of about 45°. Thus at the growing surface on the inside of the hair wall the edge is the part exposed to the protoplasm within the cell. Growth evidently takes place along a line of hydroxyl groups on this edge.

[*Cf.* Abstr. **482**, Vol. VIII. of this REVIEW.)

636. COTTON HAIR: STRUCTURE. By R. Haller. (*Helv. Chim. Acta*, **16**, 1933, p. 383. Abstr. from *Summ. of Curr. Lit.*, xiii., **12**, 1933, p. 314.) The author examines Lüdtke's statement that the cotton hair contains transverse elements which are disc-like and divide it into sections. Cotton hairs were treated with solutions of copper hydroxide in ethylene diamine and their behaviour observed. The hairs are seen to swell at intervals, and to be divided transversely by walls which really consist of contracted spiral cuticular rings, and not of solid discs. The lumen at this point is so reduced that the original cuticular ring appears to be a disc. If methylene blue is added to the ethylene diamine solution before the hair is treated, the cuticular bands are deeply stained and the cell membrane is not. The same phenomenon may be observed when the hair is treated with caustic soda and then carbon disulphide. When cotton hairs are gradually dissolved under the microscope it can be seen that they have a fibrillar structure and are probably made up of concentric elements. The cuticular rings are destroyed by mercerisation.

[*Cf.* Abstr. **231**, Vol. IX. of this REVIEW.)

637. COTTON HAIR. STRUCTURE. By J. Szymanek and O. Rohrich. (*Coton et Cult. Cotonn.*, **7**, 1933, p. 133. Abstr. from *Summ. of Curr. Lit.*, xiii., **12**, 1933, p. 314.) Previous work and theories on the structure of the cotton hair are reviewed, and the authors' own results and conclusions are described. A longitudinal section of the hair reveals that the lumen is irregular and not always cylindrical. The walls are striated longitudinally, dividing the hair into concentric cylinders. The cohesion between these layers varies, and slip planes are present at intervals, perpendicular or oblique to the axis of the hair. The hair is covered with a thin cuticle. A transverse section reveals rings of growth which do not correspond to the life in days of the hair as some workers have stated. When the hair is treated with swelling agents, it swells in the form of a necklace, round swollen sections alternating with constrictions. These constrictions are due to the presence of helical bands composed of thickenings of the cuticle, which run longitudinally along the hair and do not swell with the rest of it. Micro-photographs are reproduced.

638. COTTON HAIRS: CHANGE OF CRIMP IN PROCESSING. By E. Lipowsky. (*Spinn. u. Web.*, 51, **15**, 1933, p. 1. Abstr. from *Summ. of Curr. Lit.*, xiii., **10**, 1933, p. 255.) The crimp of cotton hairs comprises two wave forms, one of small length and amplitude and the other of comparatively great length and amplitude. The force required to remove the latter is relatively small, but perfect straightening is generally only obtained by the application of stretching forces which cause an extension of the hair. The crimping force in the hair may be measured by means of the torsion balance. In order to determine the crimp factor (ratio of length of straightened hair to that of original crimped hair) the hair is placed on a black foil smeared with a water-glycerine mixture and measured before and after repeated straightening. The opening process causes an increase in the crimp factor of raw cotton. Scutching lowers this factor again, and the value for the card sliver is about the same as that of the original cotton. Drawing processes reduce the crimp factor still farther, the effect increasing with the number of passages. Changes in the front roller speeds and pressure roller weightings have only a slight influence on the effect of the drawing process on the crimp factor.

639. Labour-Saving Dividing Compasses for Measuring Halo-Length of Cottons. By T. C. N. Singh. (*Agr. and Livestock in India*, iii., 2, 1933, p. 173.) This device, which is illustrated, consists of two arms of moderate length, each being provided with a hard, fine-pointed steel needle. A metal index, in the form of a shallow arc, is fixed on one arm, while the other free movable arm has a pointer screwed on it moving directly on the calibrated metal index, which gives the measurements in millimetres. The method of use consists in placing the point of one arm at the point of origin of the hairs to be measured, and the other point on the edge of the halo; the result, in millimetres, is indicated by the pointer on the metal index. The apparatus is said to be quick, accurate, and easy to use, the output of work nearly equalling that from the celluloid disc method.

640. Cotton Linters: Production and Utilization. By B. T. Ardashev. (*Ind. Eng. Chem.*, 25, 1933, p. 575. Abstr. from *Summ. of Curr. Lit.*, xiii., 12, 1933. p. 319.) The author first reviews mechanical and chemical methods of delinting cotton seeds, and describes the advantages, both from the oil-pressing and the sowing points of view, of the delinted seed. The latest method of delinting is by means of gaseous hydrochloric acid, complete removal of the lint being accomplished by 2 per cent. on the weight of the seed. If the treatment is carried out under mild conditions and below 60°C. germination of the seeds is unaffected. The lint is easily removed by brushing, but it represents cellulose which is considerably degraded. Owing to its low viscosity, it may be used in the manufacture of lacquers, but is useless for the rayon industry. The poorest product may be used for alcohol production by hydrolysis and fermentation. Large-scale experiments are reported in which nearly a kilo of linters could be obtained at one time, but the process is not yet run on a commercial scale. Analyses, copper numbers, and viscosities of the product are reported and discussed, and the relation between copper number and viscosity is found to agree with that established by Birtwell, Clibbens and Geake (1926).

641. Gyrator Cleaning, Blending, and Distributing Installation. (*Cotton* [U.S.], 97, 4, 1933, p. 36. Abstr. from *J. Text. Inst.*, xxiv., 7, 1933, A348.) Describes the gyrator type of cotton cleaner which has recently been developed into a combination cleaning, blending, and distributing unit.

642. Cotton: Oiling. Textile Operating Executives of Georgia. (*Cotton* [U.S.], 97, 4, 1933, p. 19. Abstr. from *J. Text. Inst.*, xxiv., 7, 1933, A348.) Some cases of gumming up of the scutcher grid bars and card cylinders and reductions of the life of travellers as a result of the application of oil to raw cotton are reported. Oil appears to improve the running of cotton which has been dyed loose. In one mill the best results have been obtained by applying the oil to the cotton after it leaves the Centrif-air machine before reaching the scutcher room. In another mill, trouble in the spinning room due to oiling was eliminated by reducing the amount of oil to 0·25 per cent. and applying it behind the feed roller on the top of the lap. Another mill has improved the condition of both white and coloured laps by applying 0·35 per cent. of oil to the cotton under the feed roller on the intermediate scutcher. It is stated that oiling assists cleaning, improves conditions in scutching and carding rooms, and gives a slight lubrication to the rings which is advantageous in spinning.

643. Scientific Cotton Stapling. Application of Modern Methods. (*Text. Weekly*, 26/ /33, p. 333.) A description of the method of using the Baer stapling apparatus.

644. Opening, Scutching, and Carding Machines: Influence on Staple. By E. Lipowsky. (*Spinn. u. Web.*, 51, 14, 1933, p. 1. Abstr. from *Summ. of Curr. Lit.*, xiii., 10, 1933, p. 246.)

645. INDIAN COTTON OPENING AND CLEANING SYSTEM (SÄCHSISCHE TEXTILMASCHINENFABRIK CORM). By R. Hartmann. (*Textilber*, **14**, 1933, p. 178. Abstr. from *J. Text. Inst.*, xxiv., **7**, 1933, A347.) Describes the preparation of mote-free condenser yarn.

646. COTTON YARNS: TWIST AND STRENGTH. By B. E. Eiben. (*Revista Text.*, 1933, iii., No. 1, p. 25; No. 2, p. 20. Abstr. from *Summ. of Curr. Lit.*, xiii., **10**, 1933, p. 256.) The author discusses the factors determining the strength of yarns and the relation between twist, diameter and count, and deduces a formula for the critical coefficient of twist.

TRADE, CO-OPERATION, ETC.

647. COTTON TRADE STATISTICS. (*Text. Weekly*, ii., **284**, 1933, p. 605.) The Economic and Statistical Dept. of the Joint Committee of Cotton Trade Organizations has prepared a new handbook of cotton trade statistics, which forms part of the service available to subscribers in continuation of the service formerly conducted by the Cotton Trade Statistical Bureau. The handbook is a loose-leaf volume containing over 300 tables, grouped and indexed for easy reference. Each section includes annual figures (covering the last ten years) and also monthly figures. Correction sheets will be issued about once a fortnight, giving the most recent figures for entry in the appropriate tables. The tables cover raw material, mechanical equipment, numbers employed, activity in spinning, weaving and finishing, import and export markets for yarn and cloth, general trade information, and an analysis of the competitive position in piecegoods in each of the world markets. To members of the various trade associations supporting the Joint Committee, the cost of the handbook is two guineas per annum; to others, three guineas.

648. A NEW USE FOR COTTON CANVAS. (*Text. Weekly*, ii., **281**, 1933, p. 535.) Cotton canvas chutes so successfully demonstrated their value as emergency fire escapes at the recent Shirokiya Dept. Store fire in Tokyo that their general use has been authorized in Japan, and all large buildings are to be equipped with them as auxiliary fire escapes. When not in use the chutes are rolled up like a large hose, and in case of fire are unreeled out of appropriate windows, and the upper ends fastened in place. These chutes might be useful as part of the equipment of volunteer fire organizations in this country.

649. THE WORLD TEXTILE INDUSTRY. By Dr. A. Niemeyer. (*Text. Rec.*, li. **604**, 1933, p. 27.) After reviewing the position in the various countries, the author considers that on the whole the picture presented by the world textile industry at the moment is one of a state of permanence. Signs of buoyancy on the one hand are offset by serious difficulties on the other. Nevertheless, it would seem as though the forces favourable to trade, released in a number of countries by an artificial or natural improvement, will slowly gain the upper hand. Important primary conditions for such a movement reside in the immense latent demand in all parts of the world, and the steadiness of prices for raw materials.

650. THE HUMAN ELEMENT IN THE TEXTILE INDUSTRIES. By T. Oliver. (*J. Text. Inst.*, xxiv., **6**, 1933, P101.) An interesting study, dealing with (*a*) the work of the supervisor, and (*b*) the work of the supervised.

651. TEXTILES IN THE NEAR EAST. By R. Flint. (*Text. Rec.*, li., **603**, 1933, p. 67.) Deals briefly with the trade situation in Turkey, Syria and Irak.

652. TECHNICAL TRAINING FOR THE COTTON INDUSTRY. By Prof. W. E. Morton. (*Text. Rec.*, li., **604**, 1933, p. 30.) To meet the general need for technical edu-

cation the author suggests that three grades of evening courses should be provided: *Grade III*, for Operatives, dealing with technical problems; *Grade II*, for Overlookers, in which mechanical details are considered; *Grade I*, for Managers and Administrators, dealing with industrial economics, administration, etc.

MISCELLANEOUS.

653. EMPIRE JOURNAL OF EXPERIMENTAL AGRICULTURE. (Oxford Univ. Press, London.) The second number of this new journal has now been issued, and contains the following among other articles: "Experimental Methods for the Study of Soil Cultivation" (B. A. Keen); "Cultivation Properties of Tropical Red Soils" (F. Hardy); "Grassland Management and its Influence on the Sward," Pt. II. (M. G. Jones); "The Analysis of Replicated Experiments when the Field Results are Incomplete" (F. Yates); "The A. I. V. Method of Preserving Fresh Fodder" (A. I. Virtanen); "Soil Profiles from Cyprus," Pt. II. (A. Reifenberg and E. K. Ewbank).

654. NORTH-WESTERN POLYTECHNIC. We have received a notice stating that evening courses in textiles—including theoretical and practical studies of the chief textiles from the retail standpoint, store management, and salesmanship—will be held at the Polytechnic on Tuesdays and Wednesdays at 7.30, beginning September 25, 1933.

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

British Guiana	Mr. E. M. Peterkin.
Gold Coast	Mr. G. G. Auchinleck.
" "	Mr. H. A. Dade.
" "	Mr. C. W. Lynn.
Kenya Colony	Mr. E. L. Bradford.
" "	Mr. M. H. Grieve.
" "	Mr. N. Humphrey.
" "	Mr. J. McDonald.

Nigeria	Mr. D. H. Brown.
,,	Mr. H. C. Doyne.
,,	Mr. R. S. Marshall.
,,	Mr. J. W. Wallace.
,,	Mr. J. F. Ward.
Nyasaland	Mr. F. Barker.
,,	Dr. W. Small.
Northern Rhodesia	Mr. F. J. S. Morkel.
Sierra Leone	Mr. F. W. B. Allinson.
,, ,,	Mr. E. S. Garner.
,, ,,	Mr. R. R. Granville.
,, ,,	Mr. J. P. Moss.
Tanganyika Territory	Mr. R. B. Allnutt.
,, ,,	Mr. J. R. Curry.
,, ,,	Mr. N. R. Fuggles.
,, ,,	Mr. H. Musk.
,, ,,	Mr. W. Nowell.
,, ,,	Mr. F. H. Smith.
,, ,,	Mr. H. H. Storey.
,, ,,	Mr. F. W. Thomas.
,, ,,	Mr. G. B. Wallace.
Uganda	Mr. G. F. Clay.
,,	Mr. D. S. Davies.
,,	Mr. G. Griffith.
,,	Mr. G. L. R. Hancock.
,,	Mr. A. J. Kerr.
,,	Mr. A. B. Killick.
,,	Mr. E. F. Martin.
,,	Mr. A. H. Ritchie.
West Indies: Trinidad	Mr. E. J. Wortley.
Zanzibar	Mr. R. Johns.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. W. L. Miller.
South Africa	Mr. S. Milligan.
Southern Rhodesia	Mr. G. S. Cameron.

We have also been notified that the following two officers from Iraq are on leave in this country: Mr. E. R. Guest and Mr. J. F. Webster.

THE EMPIRE COTTON GROWING REVIEW

INDEX OF AUTHORS TO VOL. X.

		PAGE
ABAZA, F. BEY ..	"Maarad Cotton" - - - - - -	310
ABBOTT, E. V. ..	"Enfermedades de las Plantas Cultivadas en le Peru" -	64
ABOUL ELA, G. ..	"Sand Sowing in Growing Cotton" - - -	58
ACHARD, E. ..	"La Culture du Coton en Syrie en 1932" - -	229
AFZAL, M.	"Development and Shedding of Leaves of Cotton" -	323
AFZAL, M., and SINGH, S.	"A Note on a Floral Abnormality in Cotton" - -	155
AFZAL, M., and TROUGHT, T.	"A Note on a Cross of *Gossypium Stocksii*, M. Mast., with *Gossypium indicum*, Gammie" - - -	336
AHMAD, N. ..	"Blow-room Treatment in Relation to Leafiness in Cotton" - - - - - - -	248
	"Blow-room Treatment for a Long Staple Cotton" -	302
	"Spinning Test Reports on East African and Indian Cottons" - - - - - - -	127
	"Spinning Test Reports on Indian Cottons" 43, 216.	301
	"Technological Report on Banilla Cotton, 1930-32" -	127
	"Technological Reports on Standard Indian Cottons" 43, 127,	216
ALLAN, W. ..	"The Movement and Breeding of Locust Swarm (July, 1931, to September, 1932)" - - - -	220
ALLISON, F. E. ..	"The Comparative Effects of Concentrated Nitrogenous Fertilizers on Permanent Soil Acidity" - -	141
ALTSON, A. M. ..	"The Effects of Absence of Humidity on the Eggs of *Dysdercus* spp., in the Field" - - -	327
ANSON, R. ..	"Report on the Cotton Experiment Station, Sigatoka, Fiji. 1931" - - - - - -	49
ARDASHEV, B. T. ..	"Cotton Linters: Production and Utilization" - -	340
ARDASHEV, B. T., and LEONTOV, B. I.	"The Ash Content of Cottons of Different Degrees of Ripeness" - - - - - - -	158
ARNDT, C. H. ..	"Effect of Environmental Factors upon the Amount of Injury to Cotton Seedlings by the Nema *Aphelenchus parietinus*" - - - - - - -	63
ARNDT, C. H., and CHRISTIE, J. R.	"Nematodes and Cotton 'Sore-Shin'" - - -	327
ARNOLD, C. W. B., and PAGE, H. J.	"Studies on the Carbon and Nitrogen Cycles in the Soil—II." - - - - - - -	233
ASPINALL, SIR ALGERNON	"The Imperial College of Tropical Agriculture" 165 *et seq.*	
ASSOCIATION OF COTTON TEXTILE MERCHANTS OF NEW YORK	"Ten Years of Cotton Textiles" - - -	76
ATHERTON, D. O. ..	"Queensland Pests of Cotton in the Callide Valley" -	145
ATSUKI, J., and ISHIWARA, M.	"Cotton Hair: Structure" - - - -	338
A. V.	"Treatment of Cotton Root Rot Nematode Disease" -	64
AVTONOMOV, A. I.	"Investigation in Egyptian Cottons" - - -	134
AYYAR, V. R., and AYYANGAR, G. S.	"Differentiation of Hairs on the Seed Coat of Cotton" 21 *et seq.*	
BACH, W. T., and TAUBENHAUS, J. J.	"Resistance of the Turk's Cap Hibiscus, *Malvaviscus conzattii*, to Phymatotrichum Root Rot" - -	67
BAGNALL, R. S., and CAMERON, W. L. P.	"Descriptions of Two Species of *Hercothrips* Injurious to Cotton in the British Sudan" - - -	148

		PAGE
BALLARD, E., *et al.*	"The Desert Locust, *Schistocerca gregaria*, Forsk., in Egypt"	328
BALLS, W. L. ..	"Developments in Cotton Cultivation: Sakel and its Seed Supply"	224
	"Easy Control of Moisture Content in Cotton Bales"	74
BARNSHAW, C. ..	"High Drafting: Its Economic Advantages"	251
BARRITT, N. W. ..	"The Differentiation of the Epidermal Layer in Cotton Seed—II."	183 *et seq.*
BARROS, P. DE M.	"Cotton Cultivation: Brazil"	137
BATTEN, E. T., and HUTCHINSON, T. B.	"Experiments with Lime, Fertilizers, and Varieties of Field Crops in the Cotton and Peanut Section: Virginia"	135
BAUR, E.	"Konsequenzen der Vererbungslehre fur die Pflanzenzüchtung"	70
BAYES, A. W. ..	"The Stapling of Cotton"	247
BECKETT, R. E., and HUBBARD, J. E.	"The Shedding of 4-Lock and 5-Lock Bolls in Upland Cotton"	71
BECKETT, S. H., and DUNSHEE, C. F.	"Water Requirements of Cotton on Sandy Loam Soils in Southern San Joaquin Valley"	322
BEDFORD, H. W. ..	"The Weed 'Hambuk' (*Abutilon* sp.) and the Part it Plays in the Conservation of Parasites of the Various Species of Bollworm which attack Cotton in the Sudan"	146
BELLING, J. ..	"Critical Notes on C. D. Darlington's 'Recent Advances in Cytology'"	337
BENNETT, C. A. ..	"Cotton Ginning Investigations in U.S.A."	58
BEST, R. J. ..	"A Comparison of Methods for Determining the Hydrogen-ion Concentration of Soils"	233
BODENHEIMER, F. S.	"Uberblick über die Gesamtokologie der Afrikanischen Wanderheuschreke *Schistocerca gregaria*, Forsk."	149
BRABHAM, H. K. ..	"Cotton Variety Tests, 1931"	53
BRAUN-BLANQUET, J.	"Plant Sociology: The Study of Plant Communities"	323
BRENNAN, E. ..	"Lancashire's Success in Scandinavia"	76
BRIEGER, F. ..	"Die Genaue Bestimmung des Zeitpunktes der Mendelspaltung (Sammelreferat)"	336
BRIERLEY, W. B.	"Science of the Year 1932: The Biological Sciences"	333
BRISCOE, C. F., *et al.*	"Agronomic Work in 1932: Mississippi"	228
BRITON-JONES, H. R.	"Preliminary Trials with a Combined Insecticide and Fungicide"	325
BROWN, C. H. ..	"Purity and Variability in Cotton"	108 *et seq.*
BROWN, C. H., *et al.*	"A Preliminary Note on the Physiological and Genetic Aspects of Hair Properties in Egyptian Cottons"	51
BROWN, H. B., *et al.*	"Cotton Root-Rot Developments in Certain South Louisiana Soils"	312
BROWN, J. G. ..	"Plant Pathology"	331
BRYAN, A. B. ..	"Cotton Cultivation, S. Carolina"	228
BRYAN, M. K. ..	"An Atypical Lesion on Cotton Leaves caused by *Bacterium malvacearum*"	64
BRYCE, MUIR A. ..	"How Cotton is Marketed"	252
BURGESS, J. S., and GUIN, M.	"Farm Prices of Cotton related to its Grade and Staple Length in Selected Local Markets, Seasons 1930-31 and 1931-32 (South Carolina)"	313
BUTLER, E. J. ..	"Cotton Diseases"	91 *et seq.*
	"Tropical Plant Diseases: Their Importance and Control"	239
BUTLER, R. A. ..	"Cotton: Ginning and Baling"	236
CAINE, M.	"The Significance of Yarn Tests"	250
CAMERON, W. L. P.	"*Heliothrips* sp. affecting the Rain-Grown American Cotton at Galaa el Nahl, Kassala Province"	148
	"Thrips affecting the Cotton Crop in the Gezira in 1930"	63
CARLE, G.	"La Culture du Coton en Afrique du Nord en Septembre, 1932"	137
CARTER, R. H. ..	"The Chemical Composition of Commercially Available Fluorine Compounds"	144

		PAGE
CASANOVA, O. B. ..	"Report of the Holly Springs Branch Experiment Station, Mississippi, 1931" - - - -	54
CHADWICK, S. ..	"Cotton Mill Costing System" - - - -	75
CHAKRABORTY, J. N., and SEN, A.	"Mechanical Analysis of Lateritic Soils" - -	140
CHANG, T. M. ..	"New Cotton Organizations formed in China" - -	137
CHAPTAL, L. ..	"The Measurement of Rainfall in Agricultural Climatology" - - - - - - -	236
CHARLES-PIERRE, E.	"French Cotton Exports: Statistics, 1932" - -	229
CHEVALIER, A. ..	"Le *Gossypium anomalum*. Wawra et Payr. Est-il un Cotonnier ou un *Cienfuegosia?*" - - -	336
	"Nouvelles Observations sur les Sauterelles du Sahara, du Niger et du Soudan Français" - - -	62
CHIAROMONTE, A. ..	"Comparaisons Entomologiques pour le Culture du Cotonnier entre la Colonie de l'Érythrée et la Somalie Italienne" - - - - - -	230
	"Pink Bollworm: Control in Italian Somaliland" -	326
CHRISTIDIS, B. G. ..	"La Culture du Coton en Grèce" - - -	229
CHUNILAL, MEHTA AND CO.	"Indian Cotton Chart, 1932-33" - - -	300
	"Indian Cotton Review" - - - -	79
COELHO DE SOUZA, W. W.	"Cotton Cultivation in São Paulo" - - -	315
COLENO, P. ..	"Contribution à l'Étude des Acridiens Migrateurs du Soudan" - - - - - - -	149
COMBER, N. M. ..	"An Introduction to the Scientific Study of the Soil" -	232
COOK, O. F. ..	"American Cotton: Uniformity" - - -	226
COOK, W. S. ..	"Technique for Artificial Inoculations of the Cotton Plant"	59
COOPER, H. P., *et al.*	"Field Crop Experiments (South Carolina)" - -	314
	"Soil and Fertilizer Studies in South Carolina" -	320
COTTON, R. T. ..	"The Relation of Respiratory Metabolism of Insects to their Susceptibility to Fumigants" - - -	144
COTTON TRADE STATISTICAL BUREAU	"Handbook of Cotton Trade Statistics, 1924-31" -	77
CROWTHER, E. M. ..	"Soils and Fertilizers" - - - - -	234
CROWTHER, E. M., and RICHARDSON, H. L.	"Studies in Calcium Cyanamide. I. The Decomposition of Calcium Cyanamide in the Soil and its Effects on Germination, Nitrification, and Soil Reaction" -	57
DAINGERFIELD, L. H.	"Weather and Cotton Yield, Texas" - - -	228
DANA, B. F. ..	"Soil Cultures for the Laboratory Production of Sclerotia in *Phymatotrichum omnivorum*" - -	240
DANA, B. F., *et al.*	"The Influence of Date of Planting Cotton on the Development of Root-Rot" - - - -	66
DARLINGTON, C. D.	"The Control of the Chromosomes by the Genotype, and its Bearing on Some Evolutionary Problems" -	155
	"Recent Advances in Cytology" - - -	68
DE FERRIÈRE, J. F.	"Statistical Study of Available Potassium in Certain African Soils" - - - - -	234
DE LONG, D. M. ..	"Three Species of *Empoasca* Leafhoppers known to affect Economic Plants in Haiti (including the Description of Two New Species" - - -	327
DEMIDOV, A. P. ..	"Cotton Production: Russia" - - - -	139
DEREVITZKY, N. F.	"The Investigation of the Accuracy of Comparing Means in the Experiment with a Scattered Situation of Replications" - - - - - -	322
DESAI, S. V. ..	"Influence of Green Manure and Organic Residues on Nitrogen Fixation in Soil" - - - -	320
DESHPANDE, S. R.	"A Note on Cotton of which the Famous Dacca Muslins were Made" - - - - - -	302
DHARMARAJULU, K.	"A Study of the Pathological Anatomy of the Cotton Plant in Connection with the Wilt Disease (*Fusarium vasinfectum*)" - - - - - -	67
DITMAN, L. P., and CORY, E. N.	"The Response of Corn Earworm Moths to Various Sugar Solutions" - - - - -	237
DOYLE, C. B. ..	"Sea Island Cotton: Cultivation" - - -	226

		PAGE
DREYFUS, H. ..	"Staple Fibre Cutting Device" - - - -	73
DUTCHER, R. A., and HALEY, D. E.	"Introduction to Agricultural Biochemistry" - -	78
DU TOIT, M. S., and PAGE, H. J.	"Studies on the Carbon and Nitrogen Cycles in the Soil, III." - - - - - -	233
DZHEVARLINSKY, G. P.	"Zaknihi: Its Objects and Attainments" - -	71
EDEN, S.	"Soil Erosion" - - - - - -	318
EHRLICH, J., and WOLF, F. A.	"Areolate Mildew of Cotton" - - - -	65
EIBEN, B. E. ..	"Cotton Yarns: Twist and Strength" - - -	341
ELLIS, N. R., *et al.*	"The Effect of Ingested Cottonseed Oil on the Composition of Body Fat" - - - -	59
EMPIRE MARKETING BOARD	"Fibres" - - - - - -	338
ENAN, H. BEY ..	"Note on Giza 7 and Sakha 4 Cottons" - -	310
EZEKIEL, W. N., *et al.*	"Growth of *Phymatotrichum omnivorum* in Plant Juices as correlated with Resistance of Plants to Root-Rot" - - - - - -	66
	"Report of the Fifth Annual Cotton Root-Rot Conference" - - - - - -	330
FAULKNER, O. T. ..	"Mixed Farming and Cotton Production in Northern Nigeria" - - - - -	1 *et seq.*
FAULKNER, O. T., and MACKIE, J. R.	"West African Agriculture" - - - -	162
FAURE, J. C. ..	"The Phases of Locusts in South Africa" - -	149
FEDEROV, E. E., and GEDEONOV, A. D.	"Duration of Cotton Development Phases under Various Types of Weather" - - - - -	57
FENTON, F. A. ..	"Detecting Pink Bollworms in Cotton Seeds by the X-Ray" - - - - - -	60
FICK, J. C.	"Erosion of Cultivated Lands: Practical Combative Measures" - - - - - -	318
FIELD, E. G. ..	"American Cotton-Spinning Industry: Competition" -	226
	"Cotton Mill Costing System: Application" - -	75
FIELDING, W. L. ..	"Rotation Crops" - - - -	111 *et seq.*
FIKRY, A.	"Egyptian Cotton Wilt Disease: Investigations" -	241
FLINT, R.	"Textiles in the Near East" - - - -	341
FLYOROV, K. V. ..	"On the Importance of Agrotechnical Measures improving the Heat Régime of the Soil under Cotton"	55
FOLSOM, J. W. ..	"Insect Enemies of the Cotton Plant" - - -	141
FOOSHE, G. W. ..	"American Cotton in 1931-32" - -	52, 76
FRANKLIN, W. H., and KEMP, C.	"Economic Conditions in East Africa and in Northern Rhodesia and Nyasaland, 1930-32" - - -	45
FRENCH, H. M. ..	"Cotton Gins and Cottonseed-oil Mills: Electric Driving"	143
GAINES, J. C. .	"Migration and Population Studies of the Cotton Bollworm Moth (*Heliothis obsoleta*) in Texas" - -	60
	"Reliability of Differences between Data obtained in Cotton Insect Investigations" - - -	237
	"Studies of the Progress of Boll Weevil Infestation at Various Distances from Hibernation Quarters" -	146
	"Trap Collections of Insects in Cotton in 1932" - -	326
GALPERIN, D. I., and TUMARKIN, D. I.	"Cotton Linters: Viscosity in Cuprammonium Solution"	158
GAL'PERSHTEIN, Y. M., and MORITZ, L. D.	"Control of *Schistocerca* in Turkmenistan, U.S.S.R." -	149
GARDNER, A. D. ..	"Microbes and Ultramicrobes" - - -	329
GARMAN, C. G. ..	"Factors related to Income and Costs of Production on Farms in Marshall and Dekalb Counties, Alabama, 1927-29" - - - - - -	53
GARSIDE, A. H. ..	"Cotton Yearbook of the New York Cotton Exchange"	226
GARTSIDE, F. ..	"Whither Lancashire? The Need for a New Outlook"	161
GAYRAL, G. C. ..	"Le coton en Cote d'Ivoire" - - - -	137

		PAGE
GEAKE, A.	"Raw Cotton: Magnesium Content" - - -	158
GERDES, F. L. ..	"Cotton Quality affected in Ginning Process by Moisture in Seed Cotton" - - - - -	143
GLASS, J. S. ..	"Terracing to Control Erosion" - - -	318
GOFF, C. C., and TISSOT, A. N.	"The Melon Aphid, *Aphis gossypii*, Glover" - -	237
GOKHALE, V. G., and GAYWALA, P. M.	"The Effect of the Contact of Chemical Fertilizers with Seeds on their Germination" - - -	320
GOLDING, F. D. ..	"Sodium Fluosilicate as a Poison against the Hoppers of *Locusta migratoria migratorioides*, R. and F., in Nigeria" - - - - - -	238
GOLOVIZNIN, D. D., *et al.*	"The Control of Cotton Pests by Mechanical Means" -	144
GONZALES, S. S. ..	"Further Studies of the Biology of the Migratory Locust (*Pachytylus migratorioides*, R. and F.), *Locustidæ orthoptera*" - - - - - - -	62
GOODINGS, A. C. ..	"Textile Research within the Empire" - -	76
GORE, W. R., and TAUBENHAUS, J. J.	"Anatomy of Normal and Acid-Injured Cotton Roots" -	242
GRASSELLI CHEMICAL COMPANY	"Arsenical Fungicides and Insecticides" - -	325
GRAY, E. M. ..	"Lancashire Cotton Industry: Economics" - -	160
GRAY, E. M., *et al.*	"Cotton Mill Labour: Effects of Changes in Methods of Production" - - - - -	75
GREGORY, F. G., *et al.*	"The Interrelation of Factors controlling the Production of Cotton under Irrigation in the Sudan" - -	57
HAGEN, R.	"Cultivation of Sakel Cotton: Sudan" - - -	130
HALE, G. A. ..	"The Effect of Latitude, Lengt hof Growing Season and Place of Origin of Seed on the Yield of Cotton Varieties" - - - - - - -	322
HALLER, R. ..	"Cotton Hair: Structure' - - -	339
HANSFORD, C. G. ..	"Field Experiment on Blackarm Disease of Cotton" -	330
HANTON, W. A. ..	"Improvements in Textile Machinery" - -	76
HARDY, F.	"Cultivation Properties of Tropical Red Soils" -	342
	"Saline and Alkaline Soils" - - - -	141
HARLAND, S. C. ..	"Acclimatization of Cotton in New Areas: Note on" -	206
	"Cotton Notes" - - - - -	243
	"The Genetics of Cotton" - - - -	70
	"Sixth International Congress of Genetics" - 17 *et seq.*	
	"Some Notes on Moco Cotton in Brazil" - 100 *et seq.*	
HARRIS, W. V. ..	"The Migratory Locust" - - - -	61
HARTMANN, R. ..	"Indian Cotton Opening and Cleaning System (Sächsische Textilmaschinenfabrik Corm.)" - -	341
HASELDEN, L. ..	"A Suggestion for Egypt's Cotton Growers" - -	225
HASTINGS, S. H. ..	"Irrigation and Related Cultural Practices with Cotton in the Salt River Valley, Arizona" - -	53
HAWKINS, R. S., *et al.*	"Field Crops Research, Arizona" - - -	312
	"Physiological Factors affecting the Fruiting of Cotton, with Special Reference to Boll Shedding" - -	324
HEIM DE BALSAC and ROEHRICH ..	"Étude Technologique de Cotons du Congo Belge" -	229
	"Étude Technologique d'un Coton de Perse: 'Philestan'" - - - - - -	55
HENDERSON, W. O.	"The Cotton Famine on the Continent, 1861-65" -	314
	"John Bright and Indian Cotton" - - 189 *et seq.*	
HERBERT, F. W., and HUBBARD, J. W.	"Verticillium Wilt (*Hadromycosis*) of Cotton in the San Joaquin Valley of California" - - -	68
HERZOG, R. O. ..	"Fibres: Fine Structure" - - - -	157
HETHERINGTON, J., AND SONS, LTD., and HELMSLEY, L.	"Cotton Opening and Cleaning Plant" - - -	251
HIBBARD, P. L. ..	"Estimation of Plant-available Phosphate in Soil" -	319
HILL, H.	"Cotton Spinning Machinery Developments" -	252
HIMBURY, SIR WM.	"The Progress and Development of Cotton Growing within the British Empire" - - -	44
HOLSINGER, F. E.	"Japanese Cotton Industry: Competitive Strength" -	315

		PAGE
HONCAMP, F. ..	"Handbook of Plant Nutrition and Fertilizer Theory. I. Plant Nutrition; II. Fertilizer Materials and their Use" - - - - - - - -	319
HOPKINS, J. C. F. ..	"Plant Disease and Environment in Southern Rhodesia"	329
	"*Rhizoctonia lamellifera*, Small. A Distinct Species of the *Rhizoctonia bataticola* Group of Fungi" - -	330
HORLACHER, W. R., and KILLOUGH, D. T.	"Chlorophyll Deficiencies induced in Cotton (*Gossypium hirsutum*) by Radiations" - - - -	337
	"The Production of Mutations in American Upland Cotton (*Gossypium hirsutum*) by Radiations" -	337
HOUGH, W. ..	"Encyclopædia of Cotton Fabrics" - - -	248
HOWARD, A. ..	"The Periodic Failure of American Cotton in the Punjab"	268
HUDSON, P. S. ..	"New Methods of Plant Breeding: Induced Polyploidy" - - - - - - -	336
HUNTER, H., and LEAKE, H. M.	"Recent Advances in Agricultural Plant Breeding" -	162
HURST, C. C. ..	"The Mechanism of Creative Evolution" - -	69
	"Progressive Evolution" - - - 195 *et seq.*	
HURST, H. E., and PHILLIPS, P.	"The Nile Basin" - - - - -	225
HUSAIN, M. A. ..	"Leaf-Curl in Cotton and other Plants" - -	150
HUTCHINSON, J. B.	"The Inheritance of Anthocyanin Pigmentation in Asiatic Cottons" - - - - -	154
HWANG, T. ..	"The Chinese Cotton Industry" - - -	54
HYDE, A. M. ..	"Cotton Seed: Grading" - - - -	59
IMMS, A. D. ..	"Insect Pests: Influence of Temperature and Humidity on Control" - - - - - -	59
INTERNATIONAL FEDERATION OF MASTER COTTON SPINNERS AND MANUFACTURERS' ASSOCIATIONS	"Cotton Statistics" - - - - -	77
IVANOVA, V. T., and KURENNOVA, A. M.	"The Chemical Composition of Cotton Hairs of Different Degrees of Ripeness" - - - -	158
JACK, R. W. ..	"The Locust Campaign" - - - -	238
	"The Tsetse Fly Problem in Southern Rhodesia" -	328
JACKSON, F. K., and WAD, Y. D.	"Design and Conduct of Field Experiments" - -	301
JAMES, W. O. ..	"An Introduction to Plant Physiology" - -	323
JANSSENS, P. E. A.	"Le Coton en Afrique Tropicale" - - -	136
JARVIS, T. D. ..	"The Environmental Coincidence as a Factor in Incidence and Control of Plant Diseases" - - -	239
JEFFREYS, H. ..	"Experimental Data: Theory of Errors and Least Squares" - - - - - -	162
JOEL, A. H. ..	"Soil Surveys in Western Canada—I." - - -	252
JOHNSTONE, T. W.	"Temperature Ventilation and Humidification in Indian Textile Mills: With Reference to Wet Kala Thermometer Cooling Powers" - - - -	217
JONES, G. A. ..	"Recent Agricultural Developments in Some of the Leeward and Windward Islands" - - -	308
JONES, M. G. ..	"Grassland Management and its Influence on the Sward, Pt. I." - - - - -	252
	"Grassland Management and its Influence on the Sward, Pt. II." - - - - -	342
JOURAIN, P. ..	"La culture du Coton. Comment sera aménagée la vallée du Niger" - - - - -	55
KANASH, S. S. ..	"Interspecific Hybridization within the Limits of the Cotton Plant Varieties with Different Chromosomes" - - - - - - -	334
KEARNEY, T. H. ..	"Cotton Breeding Today Works with Main Types known in Remote Past" - - - -	153

		PAGE
KEATING, F. E. ..	"Agronomic Work of the Big Spring Field Station, Texas, 1915-29" - - - - - -	54
KEEN, B. A. ..	"Experimental Methods for the Study of Soil Cultivation" - - - - - - - 317,	342
	"Soil Physics in Relation to Meteorology" - -	232
KELLERMAN, K. F.	"Ozonium Root-Rot, a Problem of the Eradication of a Soil-Infecting Fungus" - - - - -	151
KIDDER, A. F. ..	"An Unusual Cotton Plant" - - - - -	155
KILLOUGH, D. T. ..	"Breeding Varieties of Cotton to meet the Needs of Mechanical Harvesting" - - - - -	333
KING, C. J... ..	"Cotton Root-Rot Disease: Occurrence, Development and Control" - - - - - -	240
KING, C. J., and HOPE, C.	"Distribution of the Cotton Root-Rot Fungus in Soil and in Plant Tissues in Relation to Control by Disinfectants" - - - - - - -	151
KING, C. J., and LOOMIS, H. F.	"Cotton Disease Investigations at the Sacaton, Arizona, Field Station" - - - - - -	67
KING, H. H. ..	"Locusts in the Sudan, 1931" - - - - -	62
KLEIN, G.	"Handbook of the Analysis of Plant Material—I.-III." -	323
KOELSCH — ..	"The Dust Hazard in the Cotton Industry" - -	251
KONSTANTINOV, N.	"The Influence of Period of Illumination on the Development of Cotton" - - - - - -	156
KORJENIOVSKI, G. A., and PLUSHKIN, E. Z.	"Chemical and Technological Tests on Cotton Samples of Different Degrees of Ripeness" - - -	158
KOSHAL, R. S., and AHMAD, N.	"Variation in the Properties of Cotton Fibre in Relation to its Position on the Surface of the Seed—Pt. I. (1) Fibre Length; (2) Fibre Weight; (3) Fibre Strength"	72
KOTTUR, G. L. ..	"Breeding for Disease Resistance at Dharwar" -	149
KRAUTER, G. ..	"Hair Weight Determination Apparatus" - -	249
KRÄNZLIN, G., and MARCUS, A.	"Cotton" - - - - - - - - -	236
LANHAM, W. B. ..	"Geographic Distribution of Staple Lengths of American Upland Cotton Crops of 1928, 1929, and 1930" -	226
LEAKE, H. M. ..	"The Case for Chartered Companies" - - 173 *et seq.*	
	"Studies in Tropical Land Tenure" - - 78,	162
LEE, K.	"The Cotton Industry and its Future" - -	161
LEEMAN, A. C. ..	"Plant Immunity" - - - - - -	153
LEGROS, J... ..	"Cotton Growing in the Italian Colonies in Tropical Africa" - - - - - - -	230
LEVY, J.	"La Chloropicrina per la Distruzione dei Parasiti nei semi di Cotone" - - - - - -	144
LEWIS, J. W. ..	"Test for Chemically Damaged Cotton Fibres" -	247
LINDSAY, H. A. F.	"Report on the Work of the Indian Trade Commissioner during 1932-33" - - - - - -	300
LINDSEY, A. W. ..	"A Textbook of Genetics" - - - - -	247
LIPOWSKY, E. ..	"Cotton Hairs: Change of Crimp in Processing" -	339
	"Cotton Hair: Fineness" - - - - -	249
	"Opening, Scutching, and Carding Machines: Influence on Staple" - - - - - - -	340
LOFTIN, C. V. ..	"Work on the Pink Bollworm, Virgin Islands" -	61
LONGLEY, A. E. ..	"Chromosomes in Gossypium and Related Genera" -	245
LONSINGER, E. K., and RASKINA, R. L.	"Cotton Seed and Cotton Seed Oil with Relation to Ripeness" - - - - - - -	158
LÜDTKE, M., and ACHMED, H.	"Fusarium Wilt Toxin: Isolation" - - -	241
LUGARD, W. J. ..	"La Culture Cotonnière dans l'Afrique Equatoriale Française" - - - - - - -	55
MCEWEN, T. ..	"Notes on Fertilizer Trials" - - - -	220
MACHIN, W. F. ..	"African Native Clothes: Market for" - - -	160
MACKAY, A. K., and JONES, J. M. ..	"Fattening Lambs on Corn, Milo, Hegari, Wheat, and Oats with Cottonseed Cake and Alfalfa (Texas)" -	314
MACNAMARA, H. C., and HOOTON, D. R.	"Sclerotia-forming Habits of the Cotton Root-Rot Fungus in Texas Blackland Soils" - -	331

		PAGE
MADDOX, J. G. ..	"Relation of Grade and Staple Length of Cotton to Prices received by Farmers in Local Markets" -	227
MADDUX, H. T. ..	"Cotton Rust and Wilt: Control with Potash" -	331
MAHALANOBIS, P. C.	"The Effect of Fertilizers on the Variability of the Yield and the Rate of Shedding of Buds, Flowers and Bolls in the Cotton Plant in Surat" - - -	321
MAHALANOBIS, P. C., and BOSE, S. S.	"The Effect of Different Doses of Nitrogen on the Rate of Shedding of Buds, Flowers, and Bolls in the Cotton Plant in Surat" - - - - -	321
	"The Effect of the Time of Application of Fertilizers on the Yield and the Rate of Shedding of Buds, Flowers, and Bolls in the Cotton Plant in Surat" - -	321
	"A Note on the Variation of Percentage Infection of Wilt Disease in Cotton" - - - -	331
MAKAROV, A. F., and GELFAND, N. A.	"Effect of Irrigation on the Development of Cotton" -	236
MALZEV, A. I. ..	"Weeds of the Cotton Plant" - - - - -	55
MANNY, T. B. ..	"Farmers' Opinions and Other Factors influencing Cotton Production and Acreage Adjustments in the South" - - - - - - -	311
MARCHENKO, N. I.	"The Technological Properties of the Cotton Hair with Relation to the Degree of Ripeness" - -	157
MARSDEN, D. ..	"Cotton Baling Cloth: Advantages" - - -	251
MARTIN, F. J., and DOYNE, H. C.	"Sierra Leone: Soil Survey" - - - -	319
MARTIN, H. ..	"Fungicides: Laboratory Examination" - -	63
MATHUR, R. N. ..	"Leaf-Curl of Cotton in Garden Zinnias in North India" - - - - - - - -	65
MAXIMOV, N. A. ..	"The Physiological Significance of the Xeromorphic Structure of Plants" - - - -	242
MAY, J. C.	"Oversea Mechanical Transport" - - -	286
METALNIKOV, S., and METALNIKOV, S. S. Jnr.	"Utilization des Bacteries dans la Lutte contre des Insectes nuisibles aux Cotonniers" - - -	333
METALNIKOV, S. S., Jnr.	"Actions des Rayons Solaires sur les Spores de Bacteries Pathogenes pour les Insectes" - - -	332
MILES, L. E., and PERSONS, T. D.	"*Verticillium Wilt* of Cotton in Mississippi" - -	241
"MINESTA" ..	"Improving Handle and Lustre in Cotton Fabrics" -	249
MIRIMANIAN, K. P.	"A Probable Cause of the Small Response to Fertilizers in the Cotton Regions of Armenia" - - -	57
MOFFAT, V. J. ..	"Native Agriculture in the Abercorn District" -	220
MOKIN, N. N. ..	"Cotton Plant Fertilizers and Stimulants" - -	56
MOORE, J. E. ..	"A New Type Automatic Loom" - - -	251
MORGAN, T. H. ..	"The Rise of Genetics" - - - - -	152
MORTON, W. E. ..	"Technical Training for the Cotton Industry" -	341
MOSSOP, M. C. ..	"Description of Hopper Instars of the Red Locust, *Nomadacris septemfasciata*, Serv., Phase Gregaria, and Some Changes in Adult Colouration" - -	328
MUKERJI, B. K. ..	"Studies on Calcium Cyanamide—II. Microbiological Aspects on Nitrification in Soils under Varied Environmental Conditions" - - - -	57
MUKHERJEE, J. N.	"On the Nature of the Reactions Responsible for Soil Acidity. II. Titration Curves of Silicic Acid Sol, Humid Acid Sol, and Aluminium Hydroxide Sol" -	317
NASMITH, F. ..	"Richard Arkwright" - - - - -	251
NEAL, D. C., *et al.*	"Treatment of Cotton Root-Rot with Ammonia" -	67
NEAL, D. C., and WESTER, R. E.	"Effects of Anærobic Conditions on the Growth of the Cotton Root-Rot Fungus (*Phymatotrichum omnivorum*)" - - - - - -	240
	"An Undescribed Sclerotium Fungus Prevalent in North-East Texas" - - - - -	331
NEALE, S. M., and STRINGFELLOW, W. A.	"The Shrinkage of Cotton Yarn and the Viscosity of its Solutions in Aqueous Caustic Soda—Cuprammonium Hydroxide" - - - - -	74

		PAGE
NELSON, SIR A., and BESLEY, A. P.	"Cotton Goods: Wholesale and Retail Prices" - -	252
NELSON, H., and WARE, J. C.	"The Relation of Nitrogen, Phosphorus, and Potassium to the Fruiting of Cotton" - - - -	141
NERLING, O. ..	"Die Jarowisation des Getreides nach T. D. Lyssenko"	338
NESTLER, P. ..	"Impregnating Fabrics or Fibres against Puncture by Insects" - - - - - -	248
NEUMANN, W. ..	"Cotton Yarn: Influence of Salts on Strength" -	250
NEWMAN, L. H. ..	"The Breeding of Early-Ripening Varieties of Spring Wheat in Canada" - - - - -	252
NICOL, H.	"Residual Values of Leguminous Crops" - -	252
NIEMEYER, A. ..	"The European Textile Industry" - - -	251
	"The International Textile Industry" - - -	251
	"Recovery in the International Textile Industry" -	160
	"The International Textile Situation" - -	252
	"The World Textile Industry" - - 76,	341
	"Is the World Textile Industry at the Turning-Point?" -	76
NOVIKOV, V. A. ..	"The Physiology of the Cotton Plant. I. Investigation of the Processes of Assimilation. The Dynamics of the Stomatal Apparatus and the Transpiration of the Cotton Plant" - - - - -	241
OGURI, S.	"Raw Cotton and Tissue Paper: Moisture Adsorption" -	75
O'KELLY, J. F., and HULL, W. W.	"Parent-Progeny Correlation in Cotton" - -	242
OLIVER, T.	"The Human Element in the Textile Industries" -	341
OLSEN, N. A. ..	"Grade and Staple of the American Cotton Supply" -	52
OSBORN, W. M. ..	"Cotton Experiments at the Lawton (Oklahoma) Field Station, 1916-31" - - - - -	312
OUALID, W. ..	"La situation des principales branches de l'économie nationale" - - - - - -	55
OVERPECK, J. C., and CONWAY, W. T.	"Cotton Investigations" - - - - -	54
OWEN, W. L., Junr., and CALHOUN, S. L.	"Biology of the Pink Bollworm at Presidio, Texas" -	60
PAGE, A. B. ..	"Improvements in Fumigation" - - 11 *et seq.*	
PAGE, H. J. ..	"Studies on the Carbon and Nitrogen Cycles in the Soil—I." - - - - - -	233
PAOLI, G.	"Specie Nuove de *Empoasca* (Hemiptera Homoptera) e appunti di Corologia" - - - - -	237
PARNELL, F. R. ..	"Good Picking" - - - - -	282
PATEL, S. J. ..	"The F_1 Generation of a Hybrid between an American and an Asiatic Cotton" - - - -	336
PEARSE, N. S. ..	"Egyptian Cotton Industry: Its Close Relationship with Lancashire" - - - - -	224
	"Moisture Tests on Egyptian Cotton" - - -	51
PEARSON, E. O. ..	"Notes on the Genus *Dysdercus* (Hemiptera Heteroptera) in Trinidad" - - - -	327
PETERS, W. ..	"Cotton Growing" - - - - 57,	133
PETROV, E.	"Soil Fertility and the Importance of Deep Ploughing and Cultivation" - - - - -	234
PIANO, G.	"Cotton Cultivation in North Africa (Cyrenaica)" -	138
PICKARD, R. H. ..	"Fibre and Fabric" - - - - -	160
	"Research in the British Cotton Industry" - -	76
PIONTKOVSKII, Y. A.	"Data on the Biology and Ecology of the Cotton Mite, *Tetranychus* (*Epitetranychus*) sp." - - -	148
POPOV, P. V. ..	"Keys to the Pests of Cotton identified by the Damage caused and by their Injurious Stages" - -	59
PRASSOLOV, L. I. ..	"Short Survey of the Soils of the New Cotton-growing Regions in the South and South-East of U.S.S.R." -	55
PREDTECHENSKII, S.	"The Desert Locust (*Schistocerca gregaria*), Forsk., in Persia" - - - - - -	328
PURI, A. N. ..	"Interaction between Ammonia and Soils as a New Method of Determining the State of Saturation and pH Values of Soils" - - - - -	317

		PAGE
PURI, A. N. ..	"A New Type of Hydrometer for the Mechanical Analysis of Soils" - - - - - -	56
RAEVSKII, V. ..	"On the Organization of the Control of the Adult Moroccan Locust with Poisoned Bran Mash" -	62
RAMADAS, L. A. ..	"Agricultural Meteorology" - - - - -	236
RANSOMES, SIMS AND JEFFERIES, LTD.	"Ploughs and Implements for Mechanical Cultivation" -	142
RAYMOND, A. ..	"Why Japan is able to Undersell" - - - -	316
REA, H. E... ..	"The Callusing and Rooting of Cotton Stem Cuttings" -	322
	"Grafting Experiments with Cotton" - - - -	71
REEVES, R. G., and VALLE, C. C.	"Cotton Seed: Anatomy and Microchemistry" -	72
REIFENBERG, A., and EWBANK, E. K.	"Soil Profiles from Cyprus—I." - - - -	252
	"Soil Profiles from Cyprus—II." - - - -	342
RENOUARD, A. ..	"Les Fluctuations des Matières premières textiles au cours de l'année, 1932" - - - -	229
REVERE, C. T. ..	"Progress of the New Crop" - - - -	53
REYES, G. M. ..	"An Unreported Fungous Disease of the Philippine Migratory Locust" - - - - -	239
REYNOLDS, E. B., *et al.*	"Fertilizer Experiments with Cotton: Texas" - -	234
RICHARDSON, H. L.	"Studies on Calcium Cyanamide. III. Storage and Mixing with Superphosphate" - - - -	57
ROBERT, J. C., *et al.*	"Field Crop Experiments at the South Mississippi Sub-Station, 1931" - - - - - -	54
ROBERT, L. ..	"Cotton Culture in French West Africa" - -	315
ROBICZEK, H. A., and LEONHARDT, R.	"Russian Textile Industry: Condition of" - -	139
ROBINSON, G. W. ..	"The Dispersion of Soils in Mechanical Analysis" -	233
	"Soils: Their Origin, Constitution and Classification. An Introduction to Pedology" - - -	317
ROBINSON, H. ..	"Indian Cotton: Utilization in Lancashire" - -	126
ROBINSON, J. M., and ARANT, F. S.	"Eight Years of Experimental Work in Boll Weevil Control on Plots receiving Different Rates of Fertilizers"	60
RODIONOV, Z. ..	"The Sulphur Problem" - - - - -	239
RODRIGUEZ, J. M.	"The Cultivation of Cotton in the Belgian Congo and at the Bambesa Breeding Station" - - -	315
ROEHRICH, O. ..	"Cotton Hair: Ripening and Dimensions" - -	249
ROHDENDORF, B. B.	"Beiträge zur Kenntnis der Zweiflügeligen Parasiten der Acrididen" - - - - - - -	61
RUDE, C. S. ..	"Host Plant Studies of the Pink Bollworm" - -	60
	"Observations on a Combined Boll Weevil and Pink Bollworm Infestation in Northern Mexico" -	60
RYABOV, M. A. ..	"Chief Diseases and Insect Pests of Cotton in the New Regions (U.S.S.R.)" - - - - - -	55
RYTIKOV, M. G. ..	"The Collection of Samples and the Characteristics of the Materials used" - - - - - -	157
SABININ, D. A., *et al.*	"Effect of Nitrogenous Fertilizers on Cotton under Conditions of a Vegetative Experiment" - -	235
SANSOME, F. W., and PHILP, J.	"Recent Advances in Plant Genetics" - - -	152
SARAKHOV, I. P. ..	"Results of Experiments with the Cotton Plant in 1929 at the Prikum Experiment Station" - -	140
SATTERTHWAIT, A. F.	"Larval Instars and Feeding of the Black Cutworm (*Agrotis ypsilon*), Rott." - - - - -	327
SCHAFFNIT, E., and LÜDTKE, M.	"Über die Bildung von Toxinen durch Verschiedene Pflanzenparasiten" - - - - - -	332
SCHNEIDERHAN, F. J.	"Instant Bordeaux" - - - - - -	63
SCHWARTZ, P. R. ..	"Egyptian Cottons: Introduction and Deterioration" -	133
SELYANINOV, G. T.	"The Possible Climatic Limits of Cotton Growing in the European Part of U.S.S.R." - - -	55
SEN, K. R., and IYER, S. S.	"On the Variation of Certain Characters of Cotton in Relation to the Position of Seeds in a Lock" -	156
SEVER, W.	"The Measurement of Fibre Length" - - -	72
SHINODA, V. ..	"Cotton: Characterization by Solubility Curves" -	72

		PAGE
SHANKLIN, J. A., *et al.*	"Community Production of Cotton in Relation to Yield and Staple Length (South Carolina)"	313
SINGH, T. C. N.	"A Labour-Saving Dividing Compasses for Measuring Halo Length of Cottons"	340
SINNOTT, E. W., and DUNN, L. C.	"Principles of Genetics: A Textbook with Problems"	246
SKOVSTED, A.	"Cytological Studies in Cotton. I. The Mitosis and Meiosis in Diploid and Triploid Asiatic Cotton"	242
SLATER, F. P.	"The Significance of Results in Textile Testing"	76
SLOAN, G. A.	"A Basis for Profit in Cotton Manufacturing"	160
SLOWE, A. J., and SEWARD, J. W.	"Ball-drag Shuttle"	159
SMITH, E. H. G.	"Cotton Cultivation in the Southern Provinces, 1932-33"	220
SMITH, F. B., and BROWN, P. E.	"Nitrate-Assimilating Soil Bacteria"	235
SMITH, G. D.	"Weather and Weevils"	76
SMITH, H. P.	"Cotton Gins, Cotton Pickers, Cultivators, and Rakes"	325
	"Mechanization of Cotton Production"	324
	"Types of Terracing Machinery used in Texas"	319
SMITH, H. P., *et al.*	"The Mechanical Harvesting of Cotton"	143
SMITH, REV. S. R.	"Nigerian Oracles"	25 *et seq.*
SOUTHERN TEXTILE ASSOCIATION	"Cotton: Oil Spraying"	75
	"Cotton: Selection"	226
	"Cotton Neps: Causes"	73
SOYER, MME. D.	"La Désinfection des Graines de Coton"	325
SPOON, W.	"Cotton Cultivation: Dutch East Indies"	137
SRINIVASAN, A.	"Determination of Nitrogen in Soils"	141
SSUROWAJA, A. W., and VIKTOROV, P. P.	"Immature and After-Frost Cottons: Chemical Analysis"	247
STEPHENS, P. H.	"Farm Production Costs in 1931"	313
STEWART, R.	"The Mitscherlich, Wiessmann and Neubauer Methods of Determining the Nutrient Content of Soils"	56
STOCKDALE, F. A.	"Report on Visit to the West Indies, Bermuda, British Guiana and British Honduras, 1932"	78
STOUGHTON, R. H.	"The Influence of Environmental Conditions on the Development of the Angular Leafspot Disease of Cotton" IV.	150
STRAND, P. M.	"Staple Lengths of Foreign Cottons consumed in United States"	52
STREL'NIKOV, I.	"The Effect of Solar Radiation and Wind on the Temperature of the Body and the Behaviour of the Larvæ of the Locust, *Locusta migratoria*"	238
STROHMAYER, H. C.	"State of the Cotton Industry: Germany"	137
SUCHIER, A.	"Analytical Methods for Fertilizers"	57
SUNDARARAMAN, S.	"Administrative Report of the Mycologist, Madras, for the Year 1931-32"	331
SZYMANEK, J.	"Observations Caryologiques Supplémentaires sur quelques *Gossypium*"	155
SZYMANEK, J., and GAVAUDAN, P.	"Observations caryologiques sur quelques *Gossypium*"	155
SZYMANEK, J., and RÖHRICH, O.	"Cotton Hair Structure"	339
TAUBENHAUS, J. J., *et al.*	"Strangulation of Cotton Roots"	64
TAUBENHAUS, J. J., and EZEKIEL, W. N.	"Resistance of Monocotyledons to *Phymatotrichum* Root-Rot"	66
	"Seed Transmission of Cotton Wilt"	150
TAYLOR, J. S.	"Report on Cotton Insect and Disease Investigations. II. Notes on the American Bollworm (*Heliothus obsoleta*, Fabr.) of Cotton, and on its Parasite (*Microbracon brevicornis*, Wesm.)"	146
TEXTILE OPERATING EXECUTIVES OF GEORGIA	"Cotton: Oiling"	340

		PAGE
TIBILOVA — ..	"Contribution to the Biology of the Spider Mite in the Tashkent Region" - - - - -	147
TIDMORE, J. W., and WILLIAMSON, J. T.	"Experiments with Commercial Nitrogenous Fertilizers"	141
TITUS, R. N., *et al.*	"Cotton Hair Microscopy" - - - -	73
TOBLER, H. ..	"Bale Sampling Device" - - - -	157
TODD, J. A. ..	"Comparative Cotton Prices" - - - -	294
	"Cotton Statistics: Consumption and Stocks" -	33 *et seq.*
	"Cotton Statistics: India" - - -	208 *et seq.*
	"Cotton Statistics: World's Crops—American and Egyptian" - - - - -	118 *et seq.*
	"Empire Cotton Crops: Production and Consumption"	218
	"Empire Cotton Growing: Production and Consumption" - - - - - -	129
	"The World's Cotton Supplies: Why Empire Cotton is Still Needed" - - - -	81 *et seq.*
TOOTAL, BROADHURST, LEE AND CO., LTD.	"The Anti-Crease Process" - - - -	159
	"Creaseless Cotton" - - - - -	76
TRANTER, K. V. ..	"The Wearer's Point of View: Garments of Egyptian Cotton" - - - - - -	225
TREMELLONI, A. ..	"Italian Cotton Industry: Condition of" - -	137
ULM, A. H... ..	"American Cotton Growing Industry: Prospects"	310
URQUHART, A. R., *et al.*	"The Moisture Relations of Cotton: The Effect of Processing" - - - - - -	74
UVAROV, B. P. ..	"The Locust Problem: Science applied to its Solution"	149
	"Phases in South African Locusts" - - -	327
VAGELER, P. ..	"The Behaviour of the Water Content and Cations of Mineral Soils" - - - - -	319
	"An Introduction to Tropical Soils" - - -	231
VAIDEN, M. G., *et al.*	"Making Cotton Cheaper: Can Present Production Costs be Reduced?" - - - -	134
VAN DER SPUY, M. J.	"The Fight against Soil Erosion" - -	318
VAN POETEREN, N.	"Bestuiven en Bestuivers (Dusting and Dusting Apparatus)" - - - - - - -	325
VAYSSIÈRE, P. ..	"Observations Experimentales sur le Criquet Pélerin (*Schistocerca gregaria*, Forsk.)" - - -	61
VENKATARAMAN, V., and AHMAD, N.	"Examination of a Proposed Relationship between the Lea Test and the Single Thread Test Results" -	158
VERNON, H. M. ..	"Japanese Cotton Operatives: Psychological Research"	315
VIDAL, BROT, *et al.*	"Cotton Stalks: Value for Paper Making" - -	76
VINCON, C. ..	"Cotton Gin: Research on" - - - -	143
VIRTANEN, A. I. ..	"The A.I.V. Method of Preserving Fresh Fodder" -	342
VRYDAGH, J. M. ..	"Les Invasions de Criquet Migrateurs dans la Province Orientale (Belgian Congo)" - - - -	327
	"Le 'ver Rose' du Coton (*Gelechia gossypiella*, Saund.) dans les Districts des Deux Uele" - - -	237
VYSOTSKII, K. A.	"New Methods of Cotton Cultivation: Hybridization, Vegetative Propagation, New Methods of Transplanting" - - - - -	70, 236
WAD, Y. W., and TAMBE, G. C.	"A Note on Erosion in Black Cotton Soils" - -	301
WAHAB PASHA: H. E. AHMAD	"American and Egyptian Cotton" - - -	134
	"Broadening the Market for Egyptian Cotton: A Campaign in Many Lands" - - -	225
WAKSMAN, S. A., and IYER, K. R. N.	"Contribution to our Knowledge of the Chemical Nature and Origin of Humus—I. and II." - -	233
WALKER, A. C. ..	"Effect of Atmospheric Humidity and Temperature on the Relation between Moisture Content and Electrical Conductivity of Cotton" - - -	247
WARE, J. O. ..	"Cotton Variety Tests: Arkansas" - - -	135

		PAGE
WARE, J. O.	"Inheritance of Lint Colours in Upland Cotton" -	154
	"Inheritance of Lint Colours in Upland Cotton" (Review by Dr. Harland) - - - -	243
	"Inheritance of Lint Percentage in Cotton" - -	154
WELLS, W. G. ..	"Importance of Subsoil Moisture in Cotton Growing" -	321
WHITTAM, W. ..	"The 1933 American Cotton Crop" - - -	310
	"American Textile Notes" - - - 52, 226,	311
	"Conditions in the U.S. Textile Industry" - -	226
WHYTE, R. O., and HUDSON, P. S.	"Vernalization of Lyssenko's Method for the Pre-Treatment of Seed" - - - - -	337
WILKIE, J. B. ..	"Cotton Yarn: Mercerization for Strength" - -	250
WILLIAMS, C. B. ..	"The Bollworms of Cotton" - - - 273 *et seq.*	
WILLIAMS, C. B.	"Soil and Fertilizer Studies in North Carolina" -	234
WILLIAMS, C. B., *et al.*	"Field Crops Investigations, 1930-31, N. Carolina" -	228
WILLIAMS, C. O. ..	"Soil Fertility Problems in Natal" - - -	234
WILLIAMS, O. B., and GLASS, H. B.	"Agglutination Studies on *Phymatotrichum malvaceara*"	65
WILLIS, H. H. ..	"American Cotton Grading" - - - - -	134
WILLIS, L. G. ..	"Oxidation Reduction Potentials and the Hydrogen-ion Concentration of a Soil" - - - -	140
WILSON, J. D. ..	"Environmental Factors in Relation to Plant Disease and Injury: A Bibliography" - - 149,	240
WINNE, A. W., and DONOVAN, J. D.	"Old and New Cotton Fibres: Differentiation" -	73
WOLCOTT, G. N. ..	"The Infestation of Young Okra Pods by Pink Bollworm in Porto Rico" - - - -	61
WOOD, R. C. ..	"A Note-Book of Tropical Agriculture" - - -	235
YAKHONTOV, V. V.	"The Fauna of the Invertebrates Feeding on the Cotton Plant. Areas of the Distribution of Different Species in the World" - - - - - -	59
YATES, F.	"The Analysis of Replicated Experiments when the Field Results are Incomplete" - - 323,	342
ZAKHAROV, L. Z. ..	"The Locust Problem in the Northern Caucasus: The Present Status and Future Prospects" - -	149
ZAKOSHCHIKOV, A. P., *et al.*	"Microscopic Study of Cotton Hairs of Different Degrees of Ripeness" - - - -	157
ZHURAVSKAIA, N. P., *et al.*	"The Climate of the New Cotton Regions" - -	55

GENERAL INDEX TO VOL. X.

A. 19 cotton, 216
Abavit dust for seed treatment, 97
Abbondansia cotton, 138
Acala cotton, 54, 71, 207, 331
Acarapis. See Parasites
"Acclimatization of Cotton in New Areas" (Correspondence in relation to), 206
Acromania. See "Crazy-top" under Diseases
"Actions des Rayons Solaires sur les Spores de Bactéries Pathogènes pour les Insectes" (Metalnikov), 332
Adelphocoris rapidus. See Pests
African Busoga cotton, 302
"African Native Clothes: Market for" (Machin), 160
"Agglutination Studies on *Phymatotrichum omnivorum*" (Williams and Glass), 65
AGRA AND OUDH. See INDIA
Agriculture: "Chitemene" system, 220
Agriculture: "Mambwe" system, 220
"Agriculture (Native) in the Abercorn District: Northern Rhodesia" (Moffatt), 220
Agricultural Adjustment Act: America, 310
"Agricultural Biochemistry: Introduction to" (Dutcher and Haley), 78
"Agricultural Meteorology" (Ramadas), 236
"Agricultural Plant Breeding: Recent Advances in" (Hunter and Leake), 162
Agricultural Research Institutes in the U.K.: Reports on the work of, 78
Agricultural research workers in the British Empire, 1931: List of (corrigenda and addenda), 129
ALABAMA. See AMERICA
Alabama argillacea. See Cotton Leaf worm under Pests
Aleyrodes sp. (White Fly). See White Fly under Pests
Algerian brown cotton, 154
Allen cotton, 47, 155, 206, 304
Alternaria: A. gossypina, A. macrospora, A. tenuis. See Diseases
Amani Institute: Fourth Annual Report, 1931-32, 128; Conference of East African Soil Chemists, 140
AMERICA:
Agricultural Adjustment Act, 310; "The Agricultural Outlook for 1933" (Cotton), 225; breeding experiments, 53; "Breeding Varieties of Cotton to meet the Needs of Mechanical Harvesting" (Killough), 333; Carolina cotton, use of, for tyre cords, 53; "Conditions in U.S. Textile Industry" (Whittam), 226; costs of cotton production, 53, 313; cotton for airships, 76; "Cotton Baling Cloth: Advantages of" (Marsden), 251; "Cotton Crop, 1933" (Whittam), 310; "Cotton Industry, Position of" (Whittam), 52; "Cotton Industry Prospects" (Ulm), 310; cottons resistant to wilt, 95; "Cotton Insect Investigations: Reliability of Differences between Data Obtained" (Gaines), 237; "Cotton Yarns: Studies on Mercerization of, for Strength" (Wilkie), 250; "Cotton Year Book of the N.Y. Cotton Exchange" (Garside), 226; "Cottonseed Oil, Feeding Tests with Pigs" (Ellis *et al.*), 59; diseases in, 53, 64, 65, 66, 67, 92, 93, 95, 96, 98, 99, 150, 151, 240, 327, 331; fertilizer experiments, 53, 141, 227, 234, 235; "Ginning and Baling of Cotton" (Butler), 236; "Ginning Experiments" (Bennett), 58; "Grading of Cotton Seed" (Hyde), 59; harvesting experiments, 143; Industrial Recovery Public Works Act, 311; machinery, 53, 142; "Making Cotton Cheaper, etc." (Vaiden *et al.*), 134; marketing of cotton, 227; new uses for cotton, 75, 160; parasites in, 65; pests, 53, 60, 63, 93, 144, 146, 228, 237, 312, 326, 327; President Roosevelt's recommendations for farm relief, 226; "Progress of New Cotton Crop" (Revere), 53; "Proposed Duty on Cotton" (Whittam), 226; research in, 154, 243, Report of Chief of Bureau of Plant Industry, 1931-32, 134; rotation of crops, 227; seed (good), maintenance of larger supplies of, 134; soils, 234; soil erosion problems, 311; spacing experiments, 53; "Staple Lengths of Foreign Cottons Consumed in" (Strand), 52; statistics, 33, 118, 122; varietal trials, 53, 135; varieties of cotton, 53, 54, 154; "Weather and Cotton Yield" (Daingerfield), 228; "Weather and Weevils" (Smith) 76.
Alabama: costs of cotton production in, 53; fertilizer experiments, 141
Arizona: disease investigations at Sacaton, 67; experiments with Egyptian cotton, 135; "Field Crops Research" (Hawkins *et al.*), 312; "Irrigation and Related Cultural Practices with Cotton

in the Salt River Valley" (Hastings), 53. *Arkansas:* experiments, 53, 141; "Relation of Grade and Staple Length of Cotton to Prices received by Farmers in Local Markets" (Maddox), 227; "Varietal Tests" (Ware), 135. *Florida:* diseases in, 98; experiments, 53, 312; pests in, 237. *Georgia:* "Annual Report, 1932," 227; cotton holiday (suggested), 228; experiments, 227, 235; marketing, 227; "Varietal Trials, 1931" (Brabham), 53. *Louisiana:* 312. *Mississippi:* "Annual Report, 1932," 228; diseases in, 241; "Farmers' Opinions and other Factors influencing Cotton Production and Acreage Adjustments in the South" (Manny), 311; fertilizer experiments, 54. *New Mexico:* 54. *North Carolina:* 64, 228, 234. *Oklahoma:* 312, 313. *South Carolina:* "Community Production of Cotton" (Shanklin), 313; experiments to determine the grade of cotton left in the field for varying lengths of time, 135; "Farm Prices of Cotton Related to Grade and Staple Length in Selected Local Markets, 1930-31 and 1931-32" (Burgess and Guin), 313; "Field Crop Experiments" (Cooper), 314; "Improvements in Cotton Crop" (Bryan), 228; pests in, 63; "Soil and Fertilizer Studies in" (Cooper), 319. *Texas:* "Experiments carried out, 1915-1929" (Keating), 54; "Feeding Experiments" (Mackay and Jones), 314; "Fertilizer Experiments with Cotton" (Reynolds), 234; mechanical harvesting, 143; "A New Fungus (*Ozonium texanum*) attacking Cotton" (Neal and Wester), 331; pests in, 60, 65, 66, 67, 97, 150, 240, 326; research in, 337; "Shedding of 4- and 5-lock Bolls in Upland Cotton" (Beckett and Hubbard), 71; "Terracing Machinery to Control Soil Erosion" (Smith), 319; "Weather and Cotton Yields" (Daingerfield), 228. *Virginia:* 135.

American cotton: "Review of, in 1931-32" (Fooshe), 52, 76; "Grade and Staple Length of" (Olsen), 52; "Grading" (Willis). 134; "Periodic Failure of, in the Punjab" (Howard), 268; prices, 225; quality of 1931 crop, 52; Review of 1931-32 crop, in "Man. Guar. Coml." 76; "Uniformity of" (Cook), 226

"American Cotton Spinning Industry: Competition" (Field), 226

"American and Egyptian Cotton" (Wahab Pasha), 134

American Upland cotton, 337; "Geographic Distribution of Staple Lengths of" (Lanham), 226

"American Textile Notes" (Whittam), 52, 226, 311

"Ammoniate and Nitrate Nitrogen for Cotton in Water Culture," 235

Anacridium moestum. See Locusts under Pests

"An Atypical Lesion on Cotton Leaves caused by *Bacterium malvacearum*" (Bryan), 64

ANGUILLA. See WEST INDIES

Angular Leaf spot. See Diseases

Anthia artemis: A. maculicollis, A. æquilatera. See Parasites

Anthracnose. See Diseases

Anti-crease process, 76, 159

Aphelenchus parietinus. See Pests

Aphis. See Pests

Apion xanthostylum. See Pests

Appointments, 163

A.R. Busoga cotton, A.R. Jinja cotton, A.R. Kampala cotton, 127

Areolate mildew. See Mildew (areolate). See Diseases

ARGENTINA, 314

Argentine green cotton, 154

ARIZONA. See AMERICA

ARKANSAS. See AMERICA

Arkansas Rowden cotton, 142; Arkansas Rowden 40 cotton, 135

Arkwright (Richard), 251

ARMENIA, 57

Army worm. See Pests

Ascochyta gossypii. See Parasites

Ashmouni cotton, 95, 108, 134, 310

Aspergillus niger. See Diseases

Association Cotonnière Coloniale: Bulletin No. 8, 55; No. 9, 137; No. 10, 229; No. 11, 315

AUSTRALIA, 49

Automatic loom. See Looms

B. 31 cotton, 222; B. 39 cotton, 222

Bacterial disease. See Blackarm under Diseases

Bacterium cazaubon, B. ephestiæ, B. gelechiæ. See Diseases. *B. malvacearum.* See Blackarm under Diseases

Baer sorter, 340

Bagalkote cotton, 43

Bailhongal cotton, 302

Bale sampling machine, 157

Ball drag shuttle, 159

Bancroft cotton, 207

"Banilla Cotton: Technological Report on, 1930-32" (Ahmad), 127

BARBADOS. See WEST INDIES

Barberton Experiment Station, 111, 130, 282

Baroneli cotton, 155

Beauveria globulifera. See Diseases

"Beiträge zur Kenntnis der Zweiflügeligen Parasiten der Acrididen" (Rohdendorf), 61

BELGIAN CONGO, 136, 228, 229, 237, 314, 315, 327

Bemisia gossypiperda. See White Fly under Pests

Bengal cottons, 127

Bennett cotton, 66

Berar cotton, 216

Bijapur cotton, 43

Blackarm (*Bacterium malvacearum*). See Diseases
Black Rattler cotton, 206
Black rot. See Diseases
Blæoxipha filipjevi tertia. B. laticornis, B. monticola, B. rossica, B. subamericana sp. n. See Parasites
"Blow-room Treatment for Cotton" (Ahmad), 248, 302
Bokhara cotton, 95
Boll rot disease. See Diseases
Boll weevil. See Pests
Bollworm. See Pests
"Bollworms of Cotton" (Williams), 273 *et seq.*
BOMBAY. See INDIA
"Bombay Cotton Annual, 1931-32," 127
Bordeaux mixture, 63
Bourbon cotton, 100, 244
Boyd's Prolific cotton, 138
BRAZIL, 100, 102, 103, 106, 136, 137, 229, 315
"Brazil: Some Notes on Moco Cotton in" (Harland), 100 *et seq.*
Breeding experiments: America, 53; Queensland, 132; West Indies, 51; "A Historical Account of" (Kearney), 153; "Breeding for Disease Resistance at Dharwar" (Kottur), 144; "Breeding Varieties of Cotton to meet the Needs of Mechanical Harvesting" (Killough), 333
British Cotton Growing Association: 28th Annual Report, 1932, 217; Charter and Statutes of, 136; work of, 255; assistance rendered in Nyasaland, 37; West Indies, 50, 171
BRITISH GUIANA, 217
British Cotton Industry Research Association, 59, 76, 160, 218
British Textile Exhibition, 77
Broach cotton, 216, 300, 302; Broach Deshi 8 cotton, 301
BULGARIA, 94
Buri cotton, 95
BURMA, 93, 96, 97, 98

C. 15 cotton, 131; C. 402 cotton, 216; C. 520 cotton, 216
Caconema radicicola. See Root Knot under Diseases
Calcium Cyanamide: Studies on. I., II., and III., 57
CALIFORNIA, 68, 71, 97, 135, 151, 227, 312, 322
Callide Research Station, 132, 323
Cambodia cotton, 21, 23, 43, 45, 93, 303, 307; Cambodia Co. 1 cotton, 44; Cambodia Co. 2 cotton, 44
Camptobrochis sp. See Pests
Caravonica Wood cotton, 138
Carolina cotton: use for tyre cords, 53
"The Case for Chartered Companies" (Leake), 173 *et seq.*
Casuli cotton, 108
CENTRAL AMERICA, 137
CENTRAL ASIA, 62
CENTRAL PROVINCES. See INDIA
Cephalosporium. See Diseases
Cerotelium desmium. See Parasites
CEYLON, 45, 97
CHINA, 54, 137, 229, 315
"Chitemene" method of agriculture, 220
"La chloropicrina per la Distruzione del Parassiti nei semi di Cotone" (Levy), 144
"Chromosomes: Control of, by the Genotype, and its Bearing on Some Evolutionary Problems" (Darlington), 155
Chrysomelid beetle (*Mesoplatys ochroptera*). See Pests
Cienfuegosia digitata, 336
Cleveland cotton, 54; Cleveland 54 cotton, 95; Cleveland 884 cotton, 53
Coconadas cotton, 219, 304
Colletotrichum. See Seedling Blight under Diseases
"Combined Stapling Test" of Shirley Institute, 77, 247
Co-operation, 300
Corn-ear worm. See *Heliothis obsoleta* under Pests
"Corn-ear Worm Moths: Response to Various Sugar Solutions" (Ditman and Cory), 237
Corticum vagum. See Sore Shin under Diseases
Corythuca gossypii. See Pests
Costs of production, 53, 313
"Le Coton en Afrique Tropicale" (Janssens), 136
"Cotton" (Kranzlin and Marcus), 236
Cotton: for airships, 76; for roads, 75; "Ammoniate and Nitrate Nitrogen for, in Water Culture," 235; "Characterization by Solubility Curves" (Shinoda), 72; "Chlorophyll Deficiencies induced in, by Radiation" (Horlacher and Killough), 337; "Development and Shedding of Leaves of" (Afzal), 323; "Differentiation of Hairs on the Seed Coat of" (Ayyar and Ayyangar), 21 *et seq.*; "Effect of Atmospheric Humidity and Temperature on the Relation between Moisture Content and Electrical Conductivity of" (Walker), 247; "Effect of Irrigation on the Development of" (Makarov and Gelfand), 236; "Ginning and Baling" (Butler), 236; "Grafting Experiments with" (Rea), 71; "How Cotton is Marketed" (Bryce Muir), 252; "Immature and After-Frost Cottons: Chemical Analysis of" (Saurowaja and Viktorov), 247; "Influence of the Period of Illumination on the Development of" (Konstantinov), 156; "Mechanical Harvesting of" (Smith *et al.*), 143; "Moisture Relations of" (Urquhart *et al.*), 74, "New Methods of Cultivation, etc." (Vysotskii), 70, 236; new uses for cotton, 75, 160; "On the Variation of Certain Characters of, in Relation to

the Position of Seeds in a Lock" (Sen and Iyer), 156; "Parent Progeny, Correlation in" (O'Kelly and Hull), 242; "Physiological Factors affecting the Fruiting of, with Special Reference to Boll Shedding" (Hawkins), 324; "The Production of Mutations in, by Radiation" (Horlacher and Killough), 337; "Proposed Duty on Cotton in America" (Whittam), 226; "Purity and Variability in" (Brown), 108; "Quality affected in Ginning Process by Moisture in Seed Cotton" (Gerdes), 143; "Relation of Grade and Staple Length of, to Prices received by Farmers in Local Markets in Arkansas" (Maddox), 227; "The Relation of Nitrogen, Phosphorus and Potassium to the Fruiting of" (Nelson and Ware), 141; "Stapling of" (Bayes), 247; "Water Requirements of, in Southern Joaquin Valley" (Beckett and Dunshee), 322
"Cotton like Silk," 248
"Cotton Bales: Easy Control of Moisture Content in" (Balls), 74
"Cotton Baling Cloth" (Marsden), 251
"Cotton-Breeding Today Works with Main Types known in Remote Past" (Kearney), 153
Cotton bollworm. See *Heliothis obsoleta* under Pests
Cotton canvas: new use for, 341
Cotton (creaseless), 76, 159
"Cotton Development Phases: Duration of, under Various Types of Weather" (Federov and Gedeonov), 57
Cotton diseases. See Diseases
Cotton Experiment Station, St. Vincent, 51, 133, 309
"Cotton Famine on the Continent, 1861-65" (Henderson), 314
Cotton fibres. See Fibres
Cotton flea hopper. See Pests
Cotton ginning. See Ginning of Cotton
Cotton Ginning and Pressing Factories Act, India, 126, 128, 215, 300
"Cotton Goods: Wholesale and Retail Prices" (Nelson and Besley), 252
"Cotton Growing" (Peters), 57, 133
"Cotton Growing within the British Empire: Progress and Development of" (Himbury), 44
"Cotton Hair: Change of Crimp in Processing" (Lipowsky), 339; "Effect of Maturity on Properties" (a series of papers by various Russian authors, with short summaries in English), 157; "Fineness" (Lipowsky), 249; "Microscopy" (Titus *et al.*), 73; "Ripening and Dimensions" (Roehrich), 249; "Standardization of Units in Testing," 158; "Structure" (Anon.), 338; "Structure of" (Atsuki and Ishiwara), 338; (Haller), 339; (Syzmanek and Rohrich), 339; "Weight Determination Apparatus" (Kranter), 249
"Cotton Industry and its Future" (Lee), 161
"Cotton Insect Investigations: Reliability of Differences between Data obtained in" (Gaines), 237
Cotton Lands of Central America, 137; of South America, 140
Cotton leaf perforator. See Pests
Cotton Leafworm. See Pests
Cotton linters, 158, 340
Cotton looper. See Pests
Cotton manufacturing: a basis for profit, 160
Cotton Market Act, 215
Cotton mills, 75
Cotton mite (*Tetranychus epitetranychus bimaculatus*). See Pests
Cotton neps. See Neppiness in Cotton
"Cotton Notes" (Harland), 243
Cotton plant: "An Unusual Type" (Kidder), 155; "Fauna of the Invertebrates feeding on: Areas of Distribution of the Different Species in the World" (Yakhontov), 59; "Fertilizers and Stimulants" (Mokin), 56; "Insect Enemies of" (Folsom), 144; "Physiology of" I. (Novikov), 241; "Results of Experiments in 1929 at the Prikum Experiment Station" (Sarakhov), 140; "A Study of the Pathological Anatomy of, in Connection with the Wilt Disease" (Dharmarajulu), 67; "Technique for Artificial Inoculation of" (a description of the micro-manipulator), (Cook), 59
Cotton plant in Surat, fertilizer experiments on, 321
Cotton plant (lintless), 155
Cotton plant bug. See Pests
Cotton plant puller, 301
Cotton planting machine (new), 142
Cotton pressing factories in India: list of owners in 1932-33, 217
Cotton price fluctuations, 77
Cotton Research Station, Trinidad, 154, 169, 242
Cotton Roots: "Anatomy of Normal and Acid-Injured" (Gore and Taubenhaus), 242; "Strangulation of" (Taubenhaus), 64
Cotton root-rot disease. See Root-rot under Diseases
"Cotton Root Rot Nematode Disease: Treatment of" (A. V.), 64
Cotton seed. See Seed
Cotton seed bug (or Dusky cotton stainer, *Oxycarenus* sp.). See Pests
"Cotton Seed Bugs: Effect of Environmental Factors upon the Amount of Injury to, by the Nema *Aphelenchus parietinus*" (Arndt), 63
Cotton selection (Southern Textile Association), 226
Cotton square borer. See Pests
Cotton stalks: value for paper making, 76
Cotton stapling (scientific) application of modern methods to, 340

Cotton statistics. See Statistics
"Cotton Stem Cuttings: The Callusing and Rooting of" (Rea), 322
Cotton textiles. See Textiles
Cotton Trade Statistics, 341; Handbook of 1924-31, 77
Cotton Transport Act, India, 126, 128, 215, 300
Cotton wilt. See Wilt under Diseases
Cotton worm (*Alabama argillacea*). See Cotton Leafworm under Pests
Cotton yarn, 74, 250, 341
"Cotton Year Book of the N.Y. Cotton Exchange" (Garside), 226
Cottonseed cake, 314
Cottonseed oil, 59
C.P. No. 1 cotton, 216
"Crazy-top" disease. See Diseases
Creaseless cotton, 76, 159
Criquet pélerin. See Locusts under Pests
Crocidosema plebeiana. See Pests
Cutworms. See Pests
CYPRUS, 302, 303, 304
CYRENAICA, 138, 230
"Cytological Studies in Cotton. I. The Mitosis and Meiosis in Diploid and Triploid Asiatic Cotton" (Skovsted), 242
"Cytology: Recent Advances in" (Darlington), 68; "Critical Notes on" (Belling), 337

"D. 28" cotton, 219, 304
Dacca muslins, 302
DAGHESTAN, 148
"Damping-off" disease. See Diseases
Delfos cotton, 66
Delinting cotton seed, 150
Deltatype 9 cotton, 53
"La Désinfection des Graines de Coton" (Mme. D. Soyer), 325
"Developments in Cotton Cultivation: Sakel and its Seed Supply" (Balls), 224
Dharwar cotton, 43; Dharwar I. cotton, 67, 150; Dharwar II. cotton, 67, 149
Didymella lycopersici. See Diseases
"Die Genaue Bestimmung des Zeitpunktes der Mendelspaltung" (Brieger), 336
"Die Jarowisation des Getreides nach T. D. Lyssenko" (Nerling), 338
"Differentiation of the Epidermal Layer in Cotton Seed," II. (Barritt), 183
"Differentiation of Hairs on the Seed Coat of Cotton" (Ayyar and Ayyangar), 21 *et seq.*
Diparopsis castanea (Red or Sudan Bollworm). See Red Bollworm under Pests
Diplodia gossypina, *D. theobromæ*. See Diseases
"Disease (Plant) and Injury, Environmental Factors in Relation to: A Bibliography" (Wilson), 149
Diseases: "Actions des Rayons Solaires sur les Spores de Bactéries Pathogènes pour les Insectes" (Metalnikov), 332; "Cotton Diseases" (Butler), 91 *et seq.*; "Cotton Disease Investigations, Arizona" (King and Loomis), 67; "Environmental Coincidence as a Factor in Incidence and Control of Plant Diseases" (Jarvis), 239; "Environmental Factors in Relation to Plant Disease and Injury" (Wilson), 240; "Experiments in Egypt to test whether Dry Spores of Bacteria Preserve their Vitality after Long Exposure to Strong Sunlight" (Metalnikov), 332; losses caused by, 92; "Microbes and Ultramicrobes" (Gardner), 329; "Plant Disease and Environment in Southern Rhodesia" (Hopkins), 329; "Tropical Plant Diseases: their Importance and Control" (Butler), 239; "An Undescribed Sclerotium Fungus Prevalent in N.E. Texas" (Neal and Wester), 331; "Utilization des Bactéries dans la lutte contre les Insectes nuisibles aux Cotonniers" (Metalnikov and Metalnikov, Jnr.), 333; *Alternaria*, 64, 99. *Angular Leafspot:* work at Rothamsted, 150, 329; in America, 92; Brazil, 103; Southern Rhodesia, 330; Uganda, 222; West Indies, 92. *Anthracnose*, 93, 96. *Aspergillus niger*, 99; *Beauveria globulifera*, 239; *Bacterial boll disease*, 50. *Bacterium cazaubon*, 332, 333; *B. ephestiæ*, 332, 333; *B. gelechiæ*, 333; *B. malvacearum:* see Blackarm. *B. malvacearum* n. sp., 64. *Blackarm:* seed treatment to control, 96; work at Rothamsted, 150, 329; in America, 65, 92, 95; Guatemala, 95; Korea, 95; Nigeria, 95; Russia, 95; Sudan, 95, 96, 130, 306; Uganda, 48, 221, 222, 330; West Indies, 92, 95, 104. *Black rot*, 228. *Boll rots:* 99; in America, 92; Southern Rhodesia, 330; West Indies, 92. *Cephalosporum*, 99. *Corticum vagum*, 64. *Cotton root strangulation*, 64. *Crazy-top*, 53, 67. *Damping-off*, 97. *Didymella lycopersici*, 332. *Diplodia gossypina*, 98. *D. theobromæ*, 222. *Epicoccum purpurascens*, 99. *Eremothecium cymbalariæ*, 97. *Fusarium lycopersici:* see Wilt. *F. vasinfectum*, see Wilt. *Gibberella moniliformis*, 97. *Helminthosporium gossypii*, 64; *H. sativum*, 154. *Heterodera radicicola*, 64. *Internal boll disease:* Burma, 93, 97; Nigeria, 98; Russia, 97; South Africa, 97; Southern Rhodesia, 97, 221, 330; Uganda, 98; West Indies, 93, 97. *Leaf curl:* Gold Coast, 304; India, 65, 150; Nigeria, 93, 98, 103; Sudan, 93, 98, 145, 306; Tanganyika, 307. *Leaf spot*, 99. *Macrophomina phaseoli*, 97. *Mildew*, 99. *Mildew (areolate)*, 65, 99. *Nematospora coryli*, 97, 330; *N. gossypii*, 97, 222; *N. nagpuri*, 97. *Nigrospora oryzæ*, 99. *Ozonium texanum* n.sp., 331. *Phymatotrichum omni-*

vorum; see Root-rot. *Physalospora rhodina*, 99; *Phytomonas malvaceara*, 65. *Phytophthora*, 97; *P. palmivora*, 98; *P. parasitica*, 98. *Pythium*, 97. *Rhizoctonia lamellifera*, 330. *Rhizopus nigricans*, 99; *R. stolonifer*, 330. *Root knot*, 67. *Root-rot:* Fifth Annual Conference, 330; "Resistance of Acala Cotton to," 331; "Effects of Anaerobic Conditions on the Growth of" (Neal and Wester), 240; "Growth of, in Plant Tissues" (Ezekiel *et al.*), 66; "Influence of Date of Planting on the Development of" (Dana *et al.*), 66; "Occurrence, Development and Control of" (King), 240; "Resistance of Monocotyledons to" (Taubenhaus and Ezekiel), 66; "Resistance of the Turk's Cap Hibiscus to" (Bach and Taubenhaus), 67; "Sclerotia-forming Habits of, in Texas Blackland Soils" (Macnamara and Hooton), 331; "Soil Cultures for the Laboratory Production of Sclerotia in" (Dana), 240; "Studies in Arizona" (King and Loomis), 67; "Treatment of" (A. V.), 64; "Treatment of, with Ammonia" (Neal *et al.*), 67; root-rot in America, 66, 91, 93, 151, 331; California, 151; India, 301; Russia, 93; *Rust*, 99, 331. *Sclerotium rolfsii*, 97. *Seedling blight*, 331. *Soft rot*, 98. *Sore-shin:* America, 67, 93, 327; Egypt, 93, 96; Uganda, 222; West Indies, 97. *Verticillium wilt*, 68, 241. *Wilt:* "Control of, with Potash" (Maddux), 331; cottons resistant to, 95; description of, 94, 95; "Egyptian Cotton Wilt Disease: Investigations" (Fikry), 241; *Fusarium lycopersici* (wilt), 332; from tomatoes, 241; "Fusarium Wilt Toxin: Isolation of" (Lüdkte and Achmed), 241; "Investigations of Toxins Secreted by" (Schaffnit and Lüdkte), 332; "A Note on the Variation of Percentage Infection of" (Mahalanobis and Bose), 331; "A Study of the Pathological Anatomy of the Cotton Plant in Connection with" (Dharmarajulu), 67; wilt in America 94, 150; Bulgaria, 94; Egypt, 92, 95, 241; India, 43, 91, 95, 126, 149; Peru, 64, 230; Russia, 92, 94, 95; South Africa, 94

Disinfection of cotton seed, 50

"Dividing Compasses: for Measuring Halo Lengths" (Singh), 350

Dixie cotton, 95

Doba cotton, 229

Dociostaurus maroccanus. See Locusts under Pests

Domira Bay Experiment Station, 47

D. and P.L. No. 8 cotton, 53

Dusky cotton stainer (*Oxycarenus* sp.). See Cotton Seed Bug under Pests

Dust in card rooms, 59

"Dust Hazard in the Cotton Industry" (Koelsch), 251

"Dusting and Dusting Apparatus" (van Poeteren), 325

Dutch East Indies, 137

Dysdercus sp., *D. fernandi*, *D. howardi*, *D. maurus*, *D. mimus*, *D. ruficollis:* see Stainers under Pests

Earias huegeli: see Rough Bollworm under Pests. *E. insulana:* see Spiny Bollworm under Pests

Early strain cotton, 156, 323

East Africa, 63, 128

"East African Cottons: Spinning Tests on" (Ahmad), 127

East African Soil Chemists, Conference of, 140

"Economic Conditions in East Africa and in Northern Rhodesia and Nyasaland, 1930-32" (Franklin and Kemp), 45

"Economics: Lancashire Cotton Industry" (Gray), 160

Editorial: "Ten Years," 255 *et seq.*

Egypt:

Ashmouni cotton, 310; cotton cultivation, 224, 310; cottons resistant to wilt, 95; Cotton Tax: renewal of, 133; "Developments in Cotton Cultivation: Sakel and its Seed Supply" (Balls), 224; diseases, 92, 93, 95, 96, 97, 241, 332, 333; Giza cottons, 108, 110, 310; Maarad cotton, 51, 310; "The Nile Basin" (Hurst and Phillips), 225; pests in, 237, 274, 328, 332, 333; Sakha 4 cotton, 310; "Sand Sowing of Cotton" (Aboul Ela), 58; soil problems, 224; statistics, 36, 119, 122, 123; varieties of cotton, 108, 134

Egyptian cotton, experiments with, in Arizona, 155; "Introduction and Deterioration of" (Schwartz), 133; "Investigations in" (Avtonomov), 134; "Method of Testing Moisture Content of" (Balls), 74; "Moisture Tests on" (Pearse), 51; "Preliminary Note on the Physiological and Genetical Aspects of Hair Properties in" (Brown *et al.*), 51; "Purity and Variability in" (Brown), 108

"Egyptian Cotton Industry: Its Close Relation with Lancashire" (Pearse), 224

"Egyptian Cotton Number," 225

"Egyptian Cotton Wilt Disease, Investigation" (Fikry), 241

Egypto cotton, 139

Empire Cotton Crops, 214; "Production and Consumption" (Todd), 129

Empire Cotton Growing Corporation: work of, 136, 255; assistance rendered to Nyasaland, 47; South Africa, 130; Tanganyika, 131; West Indies, 133, 168, 252, 308

"Empire Journal of Experimental Agriculture," 161, 252, 342

Empire Marketing Board, 169, 170, 172, 223, 302, 329, 338

Empoasca benedettoi, E. decedens, E. decipiens, E. distinguenda, E. dolichi, E. formosana. See Pests
Empoasca canavalia, E. fabalis, E. gossypii. See Leafhoppers under Pests
"*Empoasca* (*Hemiptera-Homoptera*) Specie nuove di, e appunti di Corologia" (Paoli), 237
Enan's Brown cotton, 244
"Enfermedades de los Plantes Cultivadas en el Peru" (Abbott), 64
Entomology: Imperial Institute of, 63
"The Environmental Coincidence as a Factor in Incidence and Control of Plant Diseases" (Jarvis), 239
"Environmental Factors in Relation to Plant Disease and Injury: A Bibliography" (Wilson), 240
Ephesia kuhniella. See Pests
Epicoccum purpurascens. See Diseases
Eremothecium cymbalariæ. See Diseases
ERITREA, 138, 230
Erysiphe malachræ. See Parasites
Erythroneura lubiæ. See Pests
"Étude Technologique d'un Coton de Perse 'Philestan'" (Heim de Balsac and Roehrich), 55
"Étude Technologique d'une série de Cotons de Syrie," 56
"Evolution (Creative), The Mechanism of" (Hurst), 69
Euxoa segetum. See Pests
Experiment Stations: America, 54; Fiji, 49; India, 156; Nyasaland, 47; Queensland, 132, 321; Northern Rhodesia, 305; Russia, 140; South Africa, 111, 130, 282; Southern Rhodesia, 130, 221; West Indies, 51, 133, 309
"Experimental Data: Theory of Errors and Least Squares" (Jefferys), 162
Express cotton, 56

289 F cotton, 156, 317, 323; 4 F cotton, 156, 217, 323
Fabrics, 218, 248, 249
"Farm Prices of Cotton related to its Grade and Staple Length in Selected Local Markets, Seasons 1930-31 and 1931-32" (Burgess and Guin), 313
"Farm Production Costs in 1931, Oklahoma" (Stephens), 313
Farm Western cotton, 302
"Farmers' Opinions and other Factors influencing Cotton Production and Acreage Adjustment in the South" (Manny), 311
Fertilizers: "Analytical Methods for" (Suchier), 57; "For Cotton Plant" (Mokin), 57; "Comparative Effect of Concentrated Nitrogenous Fertilizers on Permanent Sub-acidity" (Allison), 141; "The Effect of the Contact of Chemical Fertilizers with Seeds on their Germination" (Gokhale and Gaywala), 320; "Experiments with Commercial Nitrogenous Fertilizers" (Tidmore and Williams), 141; "Influence of Green Manure and Organic Residues on Nitrogen Fixation in Soil" (Desai), 320; "Plant Nutrition and Fertilizer Theory: Handbook of" (Honcamp), 319; "Probable Cause of the Small Response to, in Cotton Regions of Armenia" (Mirimanian), 57
"Fertilizers (Nitrogenous), Effect of on Cotton under Conditions of a Vegetative Experiment" (Sabinen *et al.*), 235
Fertilizer experiments: "Ammoniate and Nitrate Nitrogen for Cotton in Water Culture," 235; "Fertilizer Experiments with Cotton" (Reynolds), 234; "Relation of Nitrogen, Phosphorus and Potassium to the Fruiting of Cotton" (Nelson and Ware), 141; Fertilizer experiments in America, 53, 54, 141, 227, 234; Cyprus, 304; India, 321; Northern Rhodesia, 220; Uganda, 320
"Fibres" Empire Marketing Board Publication, 338
"Fibres: Fine Structure" (Herzog), 157
"Fibres" (Cotton), 72, 73, 247
Fibre-cutting device, 73
"Fibre and Fabrics," Broadcasting talks by Dr. R. H. Pickard, 160
"Field Experiments: Design and Conduct of" (Jackson and Wad), 301
FIJI: "Agricultural Journal, 1932," 128; agricultural scheme, 49; Annual Bulletin of Divisional Reports, 1931, 44; Colonial Sugar Refining Company, 177; experiments, 49; Sigaloka Experiment Station, 49; spinning tests, 49; suspension of commercial cotton growing for one year, 133
FLORIDA, See AMERICA
"Fluorine Compounds: Chemical Composition of those Commercially Available" (Carter), 144
FORMOSA, 237
Fort Jameson Experiment Station, 305
FRENCH COLONIES, 55, 62, 137, 149, 229, 315
"French Cotton Exports" (Charles-Pierre), 229
"Les Fluctuations des matières premières textiles au cours de l'année, 1932" (Renouard), 229
"Fumigation, Improvements in" (Page), 11 *et seq.*
"Fungicides, Laboratory Examination of" (Marten), 63
Fusarium caucasicum, F. lycopersici, F. vasinfectum. See Wilt under Diseases

Gadag 1 cotton, 67
GAMBIA, 44, 45, 302
Garohills cotton, 155
Gatooma Experiment Station, 130, 221
Genetics: "Consequences of, for Plant Breeding" (in German), (Baur), 70; Sixth International Congress of" (Harland), 17 *et seq.*; "Principles of:

A Textbook with Problems" (Sinnott and Dunn), 246; "(Plant) Recent Advances in" (Sansome and Philp), 152; "The Rise of" (Morgan), 152; "A Textbook of" (Lindsey), 247
"Genetics of Gossypium" (Harland), 70
GEORGIA. See AMERICA
GERMANY, 137
GEZIRA. See SUDAN
Gibberella moniliformis. See Diseases
Ginneries: "Extraction of Dust from Cotton in," 59; ginneries in India, 217; Kenya, 45; Sudan, 306; Uganda, 48, 222, 307
Ginning of cotton: in America, 58, 143, 236
Gins, 143, 325
Giza 2 cotton, 110; Giza 7 cotton, 108, 134, 310; Giza 19 cotton, 110; Giza 22 cotton, 110
Glomerella gossypii. See Anthracnose under Diseases
Goghari cotton, 300
GOLD COAST, 219, 304
Gompheres sibiricus. See Parasites
Gondere cotton, 229
"Good Picking" (Parnell), 282
Gorham Lonestar cotton, 150
"Le *Gossypium anomalum*, Wawra et Peyr. Est-il un cotonnier ou un *Cienfuegosia*?" (Chevalier), 336
Gossypium arboreum cotton, 243, 334; *G. arboreum-sanguineum*, 155; *G. barbadense*, 65, 100, 334; *G. davidsonii*, 246; *G. harknessi*, 246; *G. herbaceum*, 95, 155, 156, 243, 334, 336; *G. hirsutum*, 65, 95, 100, 138, 155, 334, 337; *G. indicum*, 336; *G. nanking*, 334; *G. nanking* var. *Siamensis*, 56; *G. neglectum*, 334; *G. peruvianum*, 65, 138, 156; *G. punctatum*, 155; *G. purpurascens*, 100; *G. stocksii*, 246; "A Note on a Cross with *G. indicum*" (Afzal and Trought), 336; *G. sturti*, 246; *G. taitense*, 100, 244; *G. tomentosum*, 244; *G. vitifolium*, 65, 155
"Grafting Experiments with Cotton" (Rea), 71
GREECE, 229
Green bug. See *Nezara viridula* under Pests
"Green-stained" Sind-American cotton, 126
GUATEMALA, 95, 137
Gyrator cleaning, blending and distributing installation, 340

H. 77 cotton, 307
Hagari cotton, 44
HAITI, 327
Half-and-Half cotton, 53, 150
"'Hambuk' weed (*Abutilon sp.*) and the Part it plays in the Conservation of Parasites of the Various Bollworms which attack Cotton in the Sudan" (Bedford), 146
Hand-weaving industry, India, 43
Hartsville cotton, 155
Harvesting machinery. See Picking Machinery
"Harvesting (Mechanical): Breeding Varieties of Cotton to meet the Needs of" (Killough), 333
HAWAI, 179
Heat treatment of seed, 96, 144, 326
Heliothus obsoleta (variously designated American bollworm, corn-ear worm, cotton bollworm, risper, tomato bud worm). See Pests
Helminthosporium gossypii, *H. sativum*. See Diseases
Helopeltis bergrothi. See Pests
Herbacao cotton, 136
Hercothrips (*heliothrips*) *fumipennis*; *H. indicus*; *H. sudanensis*. See Thrips under Pests
Heterodera radicicola. See Diseases
High drafting, 251
Hite cotton, 154
Hubli-Kumpta cotton, 216; Hubli Upland cotton, 216
"Humus: Contribution to our Knowledge of the Chemical Nature and Origin of," I. and II. (Waksman and Iyer), 233
"A Hybrid between an American and an Asiatic Cotton: The F_1 Generation of" (Patel), 336
"Hybridization Experiments" (Vysotskii), 70, 236
"Hybridization (Interspecific) within the Limits of the Cotton Plant Varieties with Different Chromosomes" (Kanash), 334
"Hydrometer: A New Type for the Mechanical Analysis of Soils" (Puri), 56

Imperial Bureau of Soil Science, 231
Imperial College of Science and Technology, 252
"Imperial College of Tropical Agriculture" (Aspinall), 165 *et seq.*; Principal's Report, 1931-32, 223
Imperial Economic Conference at Ottawa, 77
Imperial Institute, 303
Imperial Institute of Entomology, 63
INDIA:
Agricultural Meteorology: new department for, at Poona, 236; breeding experiments for disease resistance at Dharwar (Kottur), 149; Broach cotton, 216, 300, 302; Co-operative Sale Societies, 300; "Cotton plant puller" to uproot cotton plants, 301; cottons resistant to wilt disease in, 95; cotton exports, 1931-32, 79; Cotton Ginning Act, 126, 128, 215, 300; cotton pressing factories, list of names and addresses of owners, 1932-33, 217; Cotton Transport Act, 126, 128, 215, 300; Dacca cotton, 302; diseases in, 43, 65, 95, 97, 149, 150, 301, 331; fertilizer experiments in Surat, 321; fumigation

of cotton seed against boll weevil, 215; Imperial Council of Agricultural Research, Report for 1931-32, 215; "Indian Trade Commissioner's Report, 1932-33" (Lindsay), 300; Karachi Association, 302; Khandesh Cotton Breeding Scheme, 128; Lloyd Barrage, 43, 217, 302; markets in, 215; pests in, 43, 126, 150, 216, 301, 326; research in, 21, 72, 126, 155, 156, 216, 217, 321, 336; Review of Agricultural Operations in 1929-30 and 1930-31, 300; "Soils: A New Hydrometer for Mechanical Analysis of" (Puri), 56; soil erosion, 301; statistics, 38, 208; Technological Research Laboratory, 43, 126, 215; varieties of cotton, 43, 44, 216, 301; Verum cotton, 301. *Agra and Oudh*, 215, 216. *Ahmedabad*, 44. *Bombay*, 43, 44, 126, 127, 215. *Central Provinces*, 126, 215, 301. *Madras*, 126, 128, 215, 331. *Mysore*, 79. *Punjab*: "Discovery of Lintless Cotton Plant in" (Afzal and Singh), 155; Operations of Department of Agriculture, 1932, Pt. I., 217; "Periodic Failure of American Cotton in" (Howard), 268; pests in, 150, 326; pink bollworm scheme, 326; research at Lyallpur Research Station, 156, 215; root-rot research scheme, 301. *Sind*, 43, 126, 217, 218

Indian Central Cotton Committee: Activities and achievements of, 126, 217, 300, 301; Annual Report, 1932, 215; diseases and pests: campaign against, 301; Publicity Bureau, 43; publicity notices, 43, 126, 215, 300; research schemes, 215, 300

Indian Cotton: "Blowroom Treatment for" (Ahmad), 248, 302; common standards for, in Indian markets, 215; Chunilal Mehta and Co.'s review of 1931-32 season, 79; impurity in tenderable quantity in, 127; "John Bright and Indian Cotton" (Henderson), 189; "Lea Test and Single Thread Test Results" (Venkataraman and Ahmad), 158; "Spinning Test Reports" (Ahmad), 43, 127, 216, 301; fees payable for, 301; "Technological Reports on" (Ahmad), 43, 127, 216; use of Indian cotton in Lancashire mills, 126

Indian cotton industry: the case for protection, 44

Indian Cotton Chart, 1932-33, 300

"Indian Textile Mills: Temperature, Ventilation and Humidification in" (Johnstone), 217

"Indore Compost Process," 217

Indore Institute of Plant Industry, 126, 215, 216, 301

Ingold cotton, 135

"The Inheritance of Anthocyanin Pigmentation in Asiatic Cottons" (Hutchinson), 154

"Inheritance of Lint Colours in Upland Cotton" (Ware), 154; "Review of" (Harland), 243

"Inheritance of Lint Percentage in Cotton" (Ware), 154

Insects. See Pests

"Insect (Cotton) Investigations: Reliability of Differences between Data Obtained" (Gaines), 237

"Insecticide and Fungicide (Combined), Preliminary Trials with" (Briton-Jones), 325

"Insecticides and Fungicides (Arsenical)" (Graselli Chemical Co.), 325

Internal boll disease. See Diseases

Instant Bordeaux, 63

Inteiro cotton, 136

"International Textile Industry: Recovery in" (Niemeyer), 160

"The Interrelation of Factors controlling the Production of Cotton under Irrigation in the Sudan" (Gregory, Crowther and Lambert), 57

Iraq, 129

Irrigation experiments, 57, 236

Ishan cotton, 100, 155, 219; Ishan A, 46, 220; Ishan D., 47; Ishan L., 47

Italy, 137, 138, 229

Italian colonies, 138, 230; Italian Somaliland, 230, 237, 326

J. N. 1 cotton, 44

Jagadir cotton, 302

Janovich cotton, 134

Japan, 72, 74, 230, 315, 316

Jassid. See Pests

Jayawant cotton, 43, 44

"John Bright and Indian Cotton" (Henderson), 189

"Journal of the University of Bombay," 43

Kabba cotton, 47

Kadi-Viramgan cotton, 43

Kalagin cotton, 43

Karunganni cotton, 43, 126, 155, 219, 304

Kasch cotton, 66, 207

Kenya Colony, 44, 45, 46

"Keys to the Pests of Cotton identified by the Damage caused, and by their Injurious Stages" (Popov), 59

Khandesh cotton, 43, 91, 127, 216

Kidney cotton, 100, 105, 220; Kidney-Sea Island cotton, 46

"Konsequenzen der Vererbungslehre für die Pflanzenzüchtung" (Baur), 70

Korea, 96

Koriba cotton, 155

Labour situation: Brazil, 136; South America (Columbia), 140

"La Culture Cotonnière dans l'Afrique Equatoriale Française" (Lugard), 55

"Lancashire Cotton Industry Economics" (Gray), 160

"Laterite Soils: Mechanical Analysis of" (Chakraborty and Sen), 140

Latur cotton, 216
"Lea Test and Single Thread Test Results: Examination of a Proposed Relationship between" (Venkataraman and Ahmad), 158
Leaf crinkle. See Leaf Curl under Diseases
Leaf curl. See Diseases
Leaf hoppers. See Pests
Leaf roller (*Sylepta derogata*). See Pests
Leaf spot. See Diseases
Legislation: Uganda, 222; West Indies (St. Vincent), 223
Light traps to control pests in Sudan, 145
Lightning Express cotton, 54
"Lint Colours in Upland Cotton, Inheritance of" (Ware), 154; review by Harland, 243
"Lint Percentage in Cotton: Inheritance of" (Ware), 154
Lintless cotton plant, 155
Lloyd Barrage, 43, 217, 302
"4-Lock and 5-Lock Bolls in Upland Cotton: Shedding of" (Beckett and Hubbard), 71
Locustævora. See Parasites
Locusts: see Pests. *Locusta migratoria, L. pardalina; Schistocerca gregaria, Nomadacris septemfasciata*: See Locusts under Pests
"Loggerhead" cottons, 105
Lone Star cotton, 54, 56, 71, 242
Looms, 218, 251
LOUISIANA. See AMERICA
Lyallpur Research Station, 156, 215
Lygus. See Pests

M/60-A/2 cotton, 217
Maarad cotton, 51, 310
Macaque (monkey) cotton, 105
Machinery: bale sampling machine, 157; chopping, 53; cultivation, 53; Ransomes, Sims and Jefferies' cultivators, etc., 142; dusting, 144; opening, 72, 251; picking (new model in Russia), 236; planting (new model), 142; spinning, 252; terracing, 319; textile, 76, 231
Macrophomina phaseoli. See Diseases
MADRAS. See INDIA
"Making Cotton Cheaper: Can Present Production Costs be Reduced?" (Vaiden *et al.*), 134
Makwapala Experiment Station, 47
"Mambwe" system of agriculture, 220
"The Manchester School," 161
MANCHURIA, 230
Marie Galante cotton, 308
"Marketing of Cotton" (Bryce Muir), 252; in America, 227, 313
Markets, India, 215
Mazabuka Experiment Station, 305
Meade cotton, 207
Mebane cotton, 54, 60, 207
"Mechanical Harvesting of Cotton" (Smith *et al.*), 143
"Mechanism of Creative Evolution" (Hurst), 69
Melon aphid. See *Aphis gossypii* under Pests
"Memoirs of the Cotton Research Station, Trinidad," Genetics, IV., 154; Genetics, V., 242
"Mendelian Segregation: The Exact Determination of the Stage at which it Occurs." A Survey of the Literature (Brieger), 336
Mermis. See Parasites
Mexican cotton, 135
MEXICO, 60, 137
Mice. See Pests
"Microbes and Ultramicrobes" (Gardner), 329
Microbracon brevicornis, M. kirkpatricki. See Parasites
"Migration and Population Studies of the Cotton Bollworm Moth (*Heliothis obsoleta*) in Texas" (Gaines), 60
Mildew. See Diseases
Mildew (areolate). See Diseases
Miller cotton, 95, 242
Million dollar cotton, 157
Missdell 1 cotton, 53
MISSISSIPPI. See AMERICA
Mississippi cotton, 54
"Mitscherlich, Wiessmann and Neubauer: Methods of Determining the Nutrient Content of Soils" (Stewart), 56
"Mixed Farming and Cotton Production in Northern Nigeria" (Faulkner), 1 *et seq.*
Moco cotton, 136, 309; "Some Notes on, in Brazil" (Harland), 100
Moglai cotton, 127
Mollisoni cotton, 155, 217, 323
MONTSERRAT. See WEST INDIES
Mp. cotton, 47
Mycosphærella areola n. sp., *M. gossypina*. See Parasites

N. 17 cotton, 46
Nanded cotton, 216
Nanking cotton, 154, 244
NATAL. See SOUTH AFRICA
Navrozky cotton, 157
Navsari cotton, 302
Nematospora coryli, N. gossypii, N. nagpuri. See Diseases
Neppiness in cotton, 73, 302
NEVIS. See ST. KITTS-NEVIS under WEST INDIES
New Guinea Sea Island cotton, 49; New Guinea Kidney cotton, 46
"New Methods of Cotton Cultivation: Hybridization, Vegetative Propagation, and New Methods of Transplanting" (Vysotskii), 70
NEW MEXICO. See AMERICA
New Selection 10 cotton, 301
New uses for cotton, 75, 160, 341
Nezara viridula (green bug). See Pests
"The Nile Basin" (Hurst and Phillips), 225
NIGERIA:
Annual Report of Agricultural Depart-

ment, 1931, 217; cotton cultivation, 1932-33, 219; cotton investigations, 1932, 46; diseases, 93, 97, 98, 99, 103; pests in, 98, 220, 231, 238; rainfall, 79; varieties of cotton, 46, 47. *Northern Provinces:* Annual Report, 1931, 128; cotton cultivation, 78, 129, 219; exports of American cotton, 1931-32, 78; "Mixed Farming and Cotton Production in" (Faulkner), 1 *et seq.* *Southern Provinces*, 79
"Nigerian Oracles" (Smith), 25 *et seq.*
Nigrospora oryzæ. See Diseases
"Nitrate assimilating Soil Bacteria" (Smith and Brown), 235
"Nitrogen (Ammoniate and Nitrate) for Cotton and Water Culture," 235
"Nitrogen (Atmospheric): Fixation of, by the Leguminosæ Bacteria," 235
"Nitrogenous Fertilizers: Effect of, on Cotton under Conditions of a Vegetative Experiment" (Sabinin *et al.*), 235
Nomadacris septemfasciata. See Locusts under Pests
NORTH CAROLINA. See AMERICA
North-Western Polytechnic, 342
Northern Caucasus, 149
N.R. Roseum cotton, 127
NYASALAND, 44, 47, 129, 220, 305
Nyasaland Upland cotton, 207

"Observations on a Combined Boll Weevil and Pink Bollworm Infestation in Northern Mexico" (Rude), 60; "Observations Caryologiques sur quelques *Gossypium*" (Szymanek and Gavaudan), 155; "Observations caryologiques Supplémentaires sur quelques *Gossypium*" (Szymanek), 155; "Observations Experimentales sur le *Criquet pélerin* (*S. gregaria*)" (Vayssière), 61; "Observations (Nouvelles) sur les Sauterelles du Sahara du Niger et du Soudan français" (Chevalier), 62
Officers on leave, 80, 163, 253, 342
Oil spraying of cotton, 75, 340
OKLAHOMA. See AMERICA
Oophagomyia plotnikovi. See Parasites
Opening machinery. See Machinery
"Opening, Scutching and Carding Machines: Influence on Staple" (Lipowsky), 340
Ophiobolus graminis. See Parasites
"Oversea Mechanical Transport" (May), 286
Oxonium Root-Rot. See Root-Rot under Diseases
Oxonium texanum n. sp. See Diseases
Oxycarenus hyalinipennis. See Cotton Seed Bug under Pests

Parasites: "On the Formation of Toxins by Various Plant Parasites" (Schaffnit and Lüdkte), 332; "Parasites of Locusts in Central Asia" (Rohdendorf), 61; *Acarapis*, 62; *Anthia artemis*, 62; *Ascochyta gossypii*, 99; *A. maculicollis*, 62; *A. æquilatera*, 62; *Blæsoxipha filipjevi tertia*, 61; *B. laticornis*, 61; *B. monticola*, 61; *B. rossica*, 61; *B. subamencana*, 61; *Cerotelium desmium*, 99; *Erysiphe malachræ*, 99; *Gomphocerus sibiricus*, 61; *Locustævora*, 61; *Mermis*, 62, 146; *Microbracon brevicornis*, 145, 147; *M. kirkpatricki*, 145, 146; *Mycosphærella areola* n. sp., 65; *M. gossypii*, 99; *Oophagomyia plotnikovi*, 61; *Ophiobolus grammis*, 332; *Ramularia areola*, 65; *Red mites*, 62, 146; *Stomatorrhina lunata*, 61, 62; *Tarsonemidæ*, 146
Pardo cotton, 244
Patos cotton, 100
PERSIA, 55, 327
Personal notes, 80, 163, 253, 342
PERU: cotton cultivation, 138, 250; cotton taxes, 139; diseases in, 64, 99, 230
Peruvian cotton, 244
Pests: Control measures, 98, 144, 145, 146; "Dusting Apparatus for" (van Poeteren), 325; "Cotton Insect Investigation: Reliability of Differences between Data Obtained" (Gaines), 237; "Cotton Insect and Disease Investigations in South Africa: Report on" (Taylor), 146; "The Fauna of the Invertebrates Feeding on the Cotton Plant" (Yakhontov), 59; "Insect Enemies of the Cotton Plant" (Folsom), 144; "Insects: The Relation of the Respiratory Metabolism of, to their Susceptibility to Fumigants" (Cotton), 144; "Insect Pests: Influence of Temperature and Humidity on Control" (Imms), 59; "Keys to the Pests of Cotton identified by the Damage caused and by their Injurious Stages" (Popov), 59; light traps to control in the Sudan, 145; "Relationship of Pests and their Parasites to 'Hambuk' Weed in the Sudan" (Bedford), 146; "Trap Collections of, in 1932" (Gaines), 326. *Adelphocoris rapidus*, 326. *Alabama argillacea:* see Cotton Leafworm. *Aphelenchus parietinus*, 63. *Aphis*, 103; *A. gossypii*, 237. *Apion xanthostylum*, 145. *Army worm*, 144. *Bemisia gossypiperda:* see White fly. *Boll weevil:* America, 53, 60, 144, 225, 228, 237, 312, 326; Mexico, 60. *Bollworm:* "Bollworms of Cotton" (Williams), 273; Gold Coast, 304; India, 43, 301; Portuguese East Africa, 230; Northern Rhodesia, 305; Southern Rhodesia, 130; Sudan, 146. *Bug* of family Tingidæ attacking cotton in St. Vincent, 309. *Camptobrochis* sp., 145. *Chrysomelid beetle*, 307. *Corn-ear worm:* see *Heliothis obsoleta*. *Corythuca gossypii*, 103. *Cotton flea hopper*, 144, 237; *Cotton leaf perforator*, 145. *Cotton leafworm:* America, 144, 326; Brazil, 102; West

Indies, 50, 309. *Cotton looper*, 145. *Cotton mite*, 146. *Cotton plant bug*, 144. *Cotton seed bug* (or Dusky cotton stainer): Brazil, 103; Southern Rhodesia, 326; South Africa, 103. *Cotton square borer*, 144. *Crocidosema plebeiana*, 146. *Cutworms*, 144, 327. *Dusky cotton stainer*: see Cotton Seed Bug. *Dysdercus fernaldi*, *D. howardi*, *D. maurus*, *D. mimus*: see Stainers. *Earias huegeli*: see Rough Bollworm. *E. insulana*: see Spiny Bollworm. *Empoasca benedettoi*, *E. descendens*, *E. decipiens*, *E. distinguenda*, *E. dolichi*, *E. formosan* (new species), 237. *Ephestia kuhniella*, 332, 333. *Erythroneura labiæ*, 237. *Euxoa segetum*, 147. *Heliothis obsoleta* (variously designated American bollworm, corn-ear worm, cotton bollworm, risper, and tomato bud worm): "Distribution of" (Williams), 279; "Migration and Population Studies in Texas" (Gaines), 60; "Response to Various Sugar Solutions" (Ditman and Cory), 237; "Two-wheel Type of Screen Trap for" (Gaines), 60; in America, 144, 326; Northern Rhodesia, 220; Southern Rhodesia, 326; Queensland, 132, 145; South Africa, 111, 146. *Helopeltis bergrothi*, 222. *Hercothrips*: see Thrips. *Jassid*: Belgian Congo, 237; Brazil, 103; Italian Somaliland, 237; Nigeria, 220, 237; Southern Rhodesia, 221; South Africa, 237, 238; Tanganyika, 145, 237, 307; Uganda, 222. *Leaf hoppers*, 327. *Leaf roller*, 45. *Locusts*: "Anti-Locust Investigations," Second International Congress, Paris, 1932, 238; "The Effect of Solar Radiation and Wind on the Temperature of the Body, and the Behaviour of the Larvæ of the Locust *L. migratoria*" (Strel'nikov), 238; "General Ecology of *S. gregaria*" (Bodenheimer), 149; "The Locust Problem" (Uvarov), 149; losses caused by, 63; "The Migratory Locust" (Harris), 61; "Further Studies of the Biology of the Migratory Locust" (Gonzales), 62; "Observations Experimentales sur le *Criquet pélerin* (*S. gregaria*)" (Vayssière), 61; "On the Organization of the Control of the Adult Moroccan Locust with Poisoned Bran Mash" (Raevskii), 62; "The Problem of," 327; "Review of the Locust Situation in Africa and Western Asia, 1930-32," 62; locusts in Belgian Congo, 327; East Africa, "Establishment of Field Laboratory to study Breeding Conditions in," 63; Egypt, 328; French Colonies, 149; Nigeria, "Sodium Fluosilicate as a Poison against the Hoppers" (Golding), 238; Nyasaland, 307; Persia, 328; Philippines, 62, 239; Northern Rhodesia, 220; Southern Rhodesia, 238, 328; Russia, 61, 62, 149, 238; South Africa, 145; "The Phases of, in South Africa" (Faure), 149; (Uvarov), 327; South America, 140; Sudan, 62, 63, 145; Tanganyika, 61, 62, 147, 307; Uganda, 48, 222. *Lygus*, 222. *Melon aphid*: see *Aphis gossypii*. *Mice*, 145. *Nezara viridula* (green bug), 93. *Phaneroptera nana*, 145. *Pink Bollworm*: "Biology of, at Presidio, Texas" (Owen and Calhoun), 60; "Detection of, in Cotton Seed by the X-Ray" (Fenton), 60; "Distribution of" (Williams), 274; "Host Plant, Studies of" (Rude), 60; "The Infestation of Young Okra Plants by, in Porto Rico" (Wolcott), 61; "Le 'Ver Rose' du Coton dans les Districts des Deux Uele" (Vrydagh), 237; in America, 60, 144, 228; Belgian Congo, 237; Brazil, 102; Egypt, 274, 332, 333; India, 216, 326; Italian Somaliland, 326; Mexico, 60; Porto Rico, 61; Sudan, 145, 146, 277, 306; Tanganyika, 145, 307; Uganda (first appearance), 48, 221, 222; West Indies, 50, 61, 223, 237, 309. *Platyedra scutigera*, 277. *Pœcilogramma striatifemur*, 145. *Psallus seriatus*, 326. *Pyrausta nubilalis*, 332. *Rats*, 48, 145. *Red bollworm*: "Distribution of" (Williams), 278; in Southern Rhodesia, 326; South Africa, 145, 147; Sudan, 145. *Red Spider* (*Tetranychus telarius*): America, 144; Russia, 147, 239. *Rough bollworm*, 132, 145. *Scale* (*black*), 103. *Scale* (*white*), 103. *Sphingid moth*, 145. *Spiny bollworm*: "Distribution of" (Williams), 278; Sudan, 146; Tanganyika, 145, 307. *Stainers*: causing internal boll disease, 93, 98; "Effects of Absence of Humidity on the Eggs of, in the Field" (Altsen), 327; "Notes on, in Trinidad" (Pearson), 327; in America, 144; Burma, 98; Nigeria, 98; Peru, 101; Portuguese East Africa, 230; Queensland, 132; Northern Rhodesia, 220, 305; Southern Rhodesia, 130, 221, 326; South Africa, 98; Sudan, 145; Tanganyika, 307; Uganda, 222; West Indies, 98, 133, 309, 327. *Stinging ant*, 103. *Syagrus rugifrons*, 111. *Sylepta derogata*: see Leaf roller. *Tarnished plant bug*: 144. *Thrips*: America, 326; Sudan, 63, 145, 148. *Tsetse fly*, 328. *Whitefly*: Brazil, 103; India, 65, 150; Sudan, 98, 145, Tanganyika, 145, 307

Phaneroptera nana. See Pests

Philestan cotton, 55

PHILIPPINES, 62, 239

Phymatotrichum omnivorum. See Root-rot under Diseases

Physalospora rhodina. See Diseases

"The Physiological Significance of the Xeromorphic Structure of Plants" (Maximov), 242

"Physiology of the Cotton Plant. I. Investigation of the Processes of assimilation" (Novikov), 241
Phytomonas malvaceara. See Diseases
Phytophthora, P. palmivora, P. parasitica. See Diseases
Picking machinery: Russia (new model), 236; Texas Station Cotton Harvester, 143
Pilion cotton, 138
Pima cotton, 135, 154, 244, 249
Pink bollworm. See Pests
"Plant Breeding: Consequences of Genetics for" (Baur), (in German), 70
"Plant Breeding, New Methods of: Induced Polyploidy" (Hudson), 336
"Plant Disease and Injury: Environmental Factors in Relation to" (Wilson), 149
"Plant Immunity" (Leeman), 153
"Plant Material: Handbook of the Analysis of, I.-III." (Klein), 323
"Plant Nutrition and Fertilizer Theory: Handbook of" (Honcamp), 319
"Plant Pathology" (Brown), 330
"Plant Physiology: An Introduction to" (James), 323
"Plant Sociology: The Study of Plant Communities" (Braun-Blanquet), 323
Platyedra scutigera. See Pests
Ploughs, 48
"Ploughs and Implements for Mechanical Cultivation," 142
Pœcilogramma striatifemur. See Pests
Port Herald Experiment Station, 47
PORTO RICO, 61, 97, 98
PORTUGAL, 139
PORTUGUESE EAST AFRICA, 230
Prices: American cotton, 225; "Comparative Cotton Prices" (Todd), 294; fluctuations of, 77; history of, 296; prices in Uganda, 223
"Progressive Evolution" (Hurst), 195 *et seq.*
Psallus seriatus. See Pests
PUNJAB. See INDIA
Punjab-American cotton, 215, 268; Punjab-American 289 F cotton, 127; 47 cotton, 216
"Purity and Variability in Cotton" (Brown), 108
Pyrausta nubilalis. See Pests
Pythium. See Diseases

Quebradinho cotton, 136
QUEENSLAND:
Ann. Rpt. of Dpt. of Agr. and Stock, 1932-32, 128; breeding experiments, 132; Callide Research Station, 132, 321; "Cotton Cultivation" (Peters), 57, 133; cotton cultivation, 1931-32, 49, 132; cotton prospects, 1932-33, 132; diseases in, 97; "Importance of Subsoil Moisture in Cotton Growing" (Wells), 321; pests in, 132, 145, 277

Rainfall: "Measurement of, in Agricultural Climatology" (Chaptal), 236; in Cyprus, 303; Nigeria, 79; South Africa, 111; West Indies, 50, 51
Rajpipla cotton, 302
Ramularia areola. See Parasites
Ratooning of cotton, Uganda, 222
Rats. See Pests
"Raw Cotton: Magnesium Content of" (Geake), 158
"Raw Cotton and Tissue Paper: Moisture Adsorption" (Oguri), 75
Red bollworm. See Pests
Red mites. See Parasites
Red spider (also designated spider mite and cotton mite). See Pests
"Replicated Experiments: The Analysis of, when the Field Results are Incomplete" (Yates), 323; "Replicated Experiments: The Investigation of the Accuracy of Comparing Means in the Experiment with a Scattered Situation of" (Derevitzky), 322
"Reports received from Experiment Stations, 1931-32," 51, 128
"Research in the British Cotton Industry" (Pickard), 76; fireproofing of fabrics at the Royal Aircraft Establishment, 218; research at Shirley Institute, 59, 76, 160, 218; in America, 154, 337; India, 21, 72, 126, 155, 156, 215, 217, 336; Japan, 72; Russia, 70, 155, 241; West Indies, 154; "Research (Textile) Within the Empire" (Goodings), 76
Rhizoctonia lamellifera, R. solani. See Diseases
Rhizopus nigricans, R. stolonifer. See Diseases
RHODESIA (NORTHERN), 217, 220, 302, 305
RHODESIA (SOUTHERN):
Cotton cultivation, 130, 221; diseases, 99, 221, 330; Gatooma Experiment Station, 130, 221; native production of cotton, feasibility of, 221; pests, 130, 221, 238, 326, 328; "Plant Disease and Environment in" (Hopkins), 329; Rpt. of Sec. Dpt. of Agr., 1932, 217; selection work, 221
Rhyne-Cook cotton, 54
Risper. See *Heliothis obsoleta* under Pests
Root-rot. See Diseases
Rosea Bhatla cotton, 217
"Rotation Crops" (Fielding), 111
Rotation of crops: America, 227; Ceylon, 45; Sudan, 47
Rothamsted Experimental Station Rpt. for 1931, 44
Rough bollworm. See Pests
Rowden cotton, 154
RUSSIA:
Acreage, 316; "Climate of New Cotton Regions" (Zhuravskaia), 55; cotton cultivation since 1914, 139; new methods of cultivation, 70; "Cotton Production" (Demidov), 139; diseases, 92, 93, 95; "The Influence of Period of Illumination on the Development of

Cotton" (Konstantinov), 156; fertilizer experiments, 235; hybridization experiments, 70, 334; irrigation experiments. 236; new cotton picker, 236; parasites in, 61; pests, 59, 61, 144, 147, 148, 149, 238, 239; Prikum Experiment Station, 140; research, 70, 155-158, 241; "La Situation Cotonnière en Russie Sovietique" 137; soil problems, 234; "Textile Industry: Condition of" (Robiczek and Leonhardt), 139; textile machinery: extensive repairs ordered, 231; varieties of cotton, 155
Russian cotton: imports by Great Britain, 56
Rust. See Diseases
Rustenburg Experiment Station, 130

Sakel cotton, 55, 108, 137, 224, 244, 302
"Sakel Cotton: Cultivation of, in the Sudan" (Hagen), 130
Sakha 4 cotton, 109, 310
SALVADOR, 137
"Sand Sowing of Cotton" (Aboul Ela), 58
Sannahatti Selection 69 cotton, 79
Saria cotton, 155
Scale. See Pests
SCANDINAVIA, 76
Schistocerca gregaria. See Locusts under Pests
"Science of the Year 1932" (Brierley), 333
Scientific and Industrial Research, Dpt. of, Rpt. for 1931-32, 217, 218
Sclerotium rolfsii. See Diseases
Sea Island cotton, 49, 100, 133, 226, 237, 308; "Cultivation" (Doyle), 226
Secours cotton, 56
Seed: "Abavit" dust treatment, 97; "Anatomy and Microchemistry" (Reeves and Valle), 72; delinting of, 150; "Differentiation of the Epidermal Layer in," II. (Barritt), 183; "Experiments in Connection with the Transmission of Cotton Wilt by" (Taubenhaus and Ezekiel), 150; disinfection of, 50; "Grading of, in America" (Hoyle), 59; heat treatment of, 96, 144; maintenance of larger supplies of good seed in America, 134; the seed question in Egypt, 224; "Treatment by Chloropicrin to Control Pests" (Levy), 144; "Vernalization of Lyssenko's Method for the Pre-Treatment of" (Whyte and Hudson), 337; "A Brief Account of the Results Referred to in the Foregoing" (Nerling), 337; X-raying of seed, 337
Seedling blight. See Diseases
Selection work: Brazil, 104; Gambia, 45; Nigeria, 220; Southern Rhodesia, 221; Uganda, 221, 222; West Indies, 50
S.G. 238 cotton, 222; S.G. 27 cotton, 47; S.G. 29 cotton, 46, 47, 48, 221; S.G. 129 cotton, 222
SHANGHAI, 137
Shirley Institute, 59, 76, 160, 218
SIAM, 56
Sibut cotton, 229
SIERRA LEONE, 319
Sigatoka Experiment Station, 49
Simon's heater, 326
SIND. See INDIA
"Skinner's Cotton Trade Directory of the World, 1932-33," 161
Soft rot disease. See Diseases
Soils: "A Comparison of Methods for determining the Hydrogen-ion Concentration of" (Best), 233; "Comparative Effects of Concentrated Nitrogenous Fertilizers on Permanent Soil Acidity" (Allison), 141; "Contribution to our Knowledge of the Chemical Nature and Origin of Humus," I. and II. (Waksman and Iyer), 233; "Determination of Nitrogen in," I. (Srinivasan), 141; "The Dispersion of, in Mechanical Analysis" (Robinson), 233; "Estimation of Plant Available Phosphate in" (Hibbard), 319; "Experimental Method for the Study of Soil Cultivation" (Keen), 317; "Interaction between Ammonia and Soils as a New Method of determining the State of Saturation and pH Value of Soils" (Puri), 317; "An Introduction to the Scientific Study of" (Comber), 232; "Lateritic Soils: Mechanical Analysis of" (Chakraborty and Sen), 140; "The Mitscherlich, Wiessmann and Neubauer Methods of determining the Nutrient Content of" (Stewart), 56; "A New Type of Hydrometer for the Mechanical Analysis of" (Puri), 56; "On the Nature of the Reactions Responsible for Soil Acidity," II. (Mukherjee *et al.*), 317; "Nitrogen Fixation in: Influence of Green Manure and Organic Residues on" (Desai), 320; "The Origin, Constitution and Classification of" (Robinson), 317; "Oxidation-Reduction Potentials and the Hydrogen-ion Concentration of" (Willis), 140; "Saline and Alkaline Soils" (Hardy), 141; "Soil Cultures for the Laboratory Production of Sclerotia in *Phymatotrichum omnivorum*" (Dana), 240; "Soil and Fertilizer Studies in North Carolina" (Williams), 234; "Soil and Fertilizer Studies in South Carolina" (Cooper), 319; soil problems in Egypt, 224; "Soil Fertility Problems in Natal" (Williams), 234; "Soil Fertility and the Importance of Deep Ploughing and Cultivation" (Petrov), 234; "Statistical Study of Available Potassium in Certain African Soils" (de Ferrière), 234; "Studies on the Carbon and Nitrogen Cycles in," I.-III.—a group of papers from Rothamsted by H. J. Page, C. W. B. Arnold, and M. M. S. du Toit, 233

"Soils (Mineral): The Behaviour of the Water Content and Cations of" (Vageler), 319
"Soils (Tropical): An Introduction to" (Vageler), 163, 231
"Soil Bacteria: Nitrate Assimilating" (Smith and Brown), 235
Soil Chemists: Conference of, at Amani, 140
Soil erosion, 301, 311, 318, 319
"Soil Physics in Relation to Meteorology" (Keen), 232
Soil Science: Imperial Bureau of, 231
"Soil Survey in Sierra Leone" (Martin and Doyne), 319
"Soils and Fertilizers" (Crowther), 234; List of publications relating to, 140
Sore-shin disease. See Diseases
SOUTH AFRICA:
Barberton Experiment Station, 111, 130; cotton cultivation, 1931-32, 129, 130; "Cotton Insect and Disease Investigations: Report on" (Taylor), 146; cotton prospects, 1932-33, 130; diseases, 94, 97, 146; Empire Cotton Growing Corporation, assistance rendered by, 130; "Good Picking" (Parnell), 282; Natal: soil fertility problems, 234; Official Year Book, 1930-31, 44; pests in, 98, 111, 145, 146, 149, 237, 238, 327; rainfall, 111; "Rotation of Crops" (Fielding), 111; Rustenburg Experiment Station, 130; soil erosion, 318
SOUTH AMERICA, 76, 140
SOUTH CAROLINA. See AMERICA
South-Eastern Agricultural College, Wye, "The Journal," January, 1933, 128; July, 1933, 302
S.P. 13 cotton, 222
Spacing experiments: America, 53; Cyprus, 304; Uganda, 222; West Indies, 223
Spermopthora gossypii. See Diseases
Sphingid moth. See Pests
Spider mite. See Red Spider under Pests
Spinning machinery. See Machinery
Spinning tests: on Fijian cotton, 49; at Shirley Institute, 218; "Spinning Tests on Indian Cottons" (Ahmad), 43, 127, 216, 301
Spiny bollworm. See Pests
Sproull cotton, 154
Stainers. See Pests
Statistics: Handbook of Cotton Trade Statistics, 1924-31, 77; Publication of booklet on cotton statistics by International Federation of Master Cotton Spinners and Manufacturers Associations, 77; "Consumption and Stocks" (Todd), 33 *et seq.*; Empire Cotton crops, 214; statistics, America, 33, 118, 122; Egypt, 36, 119, 122, 123; India, 38, 208; World's cotton crops, 120, 121
Stinging ant. See Pests
ST. KITTS-NEVIS. See WEST INDIES
ST. LUCIA. See WEST INDIES
Stomatorrhina lunata. See Parasites
Stoneville 2 cotton, 227
Strain L. cotton, 219
ST. VINCENT. See WEST INDIES
"Subsoil Moisture in Cotton Growing: Importance of" (Wells), 321
SUDAN:
Ann. Rpt. of Coml. Intelligence Branch, 1931-32, 44; Ann. Rpt. of Dept. of Agr., 1932, 302; Ann. Rpt. of Govt. Chemist, 1932, 302; Ann. Rpt. of Govt. Entomologist, 1930, 44; 1931, 145; 1932, 302; cotton cultivation, 1931-32, 306; "Cotton under Irrigation" (Gregory, Crowther and Lambert), 57; "Cultivation of Sakel Cotton in" (Hagen), 130; diseases in, 93, 95, 96, 98, 130, 145, 306; Gezira Irrigation Project, 145, 148, 175; ginneries, 306; "'Hambuk' Weed and the Part it plays in the Conservation of Parasites of the Various Bollworms attacking Cotton in the Sudan" (Bedford), 146; parasites in, 145; pests in, 62, 63, 145, 148, 237, 277, 306
Sudan bollworm. See Red bollworm under Pests
Sudan Plantations Syndicate, 47, 175
"Sulphemulsol" combined insecticide and fungicide, 325
"The Sulphur Problem" (Rodionov), 239
Sunflower cotton, 206
Sunshine cotton, 66
Surat cotton, 302; Surat 1027 A. L. F. cotton, 44, 72, 216
SWAZILAND, 306
Syagrus rugifrons. See Pests
Sylepta derogata. See Leaf roller under Pests
SYRIA, 56, 229

T. 66/126 cotton, 304
TANGANYIKA:
Amani Institute, 128, 131, 140; Ann. Rpt. of Dept. of Agr., 1930, 47; 1931, 128; 1932, 302; Cotton Advisory Board, 131, 307; cotton cess, 131, 307; cotton cultivation, 1931, 47, 130; 1932, 307; cotton prospects, 131, 221, 307; diseases, 97, 99; Empire Cotton Growing Corporation: visit of Mr. Milligan, 131; experiments in 1930, 47; 1931, 131; 1932, 307; parasites in, 62, 146; pests, 48, 61, 145, 237; U. 4 cotton in, 131; Trade Report, 1932, 217; varietal trials, 131; varieties of cotton in, 47, 131, 307
Tanguis cotton, 139; suggested cultivation of, in Egypt, 225
Tarnished plant bug. See Pests
Tarsonemidæ. See Parasites
TASHKENT, 147
"Technological Report on Banilla Cotton, 1930-32" (Ahmad), 127; "Technological Reports on Indian Cotton" (Ahmad), 43, 127, 216

Technological Research Laboratory, Bombay, 126, 215, 301
"Technical Training for the Cotton Industry" (Morton), 341
"Ten Years" Editorial, 255
Tetranychus (*Epitetranychus*) *bimaculatis*. See Cotton Mite under Pests; *Tetranychus telarius*. See Red Spider under Pests
TEXAS. See AMERICA
Texas Green Lint cotton, 244
Texas Rust cotton, 154
Texas Station cotton harvester, 143
"Textile Industry in America, Conditions in" (Whittam), 226; "Textile Industry, European" (Niemeyer), 251; "Textile Industry, International" (Niemeyer), 251; "Textile Industry, World" (Niemeyer), 341; "Textile Industries: The Human Element in" (Oliver), 341
Textile machinery. See Machinery
Textile mills in India, 217
"Textile Recorder Year Book, 1933," 250
"Textile Research within the Empire" (Goodings), 76
"Textile Situation: International" (Niemeyer), 252
"Textile Testing: Significance of Results in" (Slater), 76
"Textiles in the Near East" (Flint), 341
"Textiles (Cotton), Ten Years of," 76
"Textiles (World): With a Review of American Cotton," 76
Thrips. See Pests
Thurberia thespesioides, 246
Tinnevelly cotton, 43
Tomato bud worm. See *Heliothis obsoleta* under Pests
"Transport: Oversea Mechanical" (May), 286
Trice cotton, 135, 154, 242
Triumph cotton, 55; Triumph Navrotskii cotton, 134
"Tropical Agriculture: A Note-Book of" (Wood), 235
"Tropical Land Tenure" (Leake), 162
"Tropical Plant Diseases: their Importance and Control" (Butler), 239
TURKEY, 56, 97
TURKMENIA, 145

U. 4 cotton: Nigeria, 47; Nyasaland, 47, 129; Northern Rhodesia, 220, 306; Southern Rhodesia, 130; Tanganyika, 47, 307
U. 4/4 cotton: Northern Rhodesia, 306; Tanganyika, 307
U. 4.4.2 cotton: Tanganyika, 131, 307; Uganda, 222
U. 4.4.10 cotton: Tanganyika, 131, 307
U. 4/64 cotton, 221;
U. 4/64/V. cotton, 221
"Über die Bildung von Toxinen durch verschiedene Pflanzenparasiten" (Schaffnit and Lüdkte), 332
UGANDA:
Ann. Rpt. Dpt. of Agr., 1931, Pt. I., 44; Pt. II., 217, 222; cotton cultivation, 1931-32, 48, 221; Cotton Export Duty Ordinance, 48; cotton industry, 1931-32, 48; 1932-33, 222; cotton prices, 223; cotton production, 1932-33, 131, 307; cotton prospects, 48, 132, 307; cotton reports of agricultural staff, 1931-32, 222; correspondence *re* Dr. Harland's article "Acclimatization of Cotton in New Areas," 206; diseases, 48, 97, 98, 99, 221, 222, 330; fertilizer experiments, 320; ginneries, 48, 222, 307; legislation, 222; pests, 48, 221, 222; pink bollworm, first appearance of, 48, 221, 222; ploughing in, 48; ratooning of cotton, 222; selection work, 221, 222; spacing experiments, 222; varietal trials, 222; varieties of cotton in, 206, 222
Ujjain cotton, 127, 216
Umri Bani cotton, 127
U.P. cotton, 44
"Upland Cotton: Shedding of 4- and 5-Lock Bolls in" (Beckett and Hubbard), 71
Uppam cotton, 126, 331
Upright cotton, 154
UZBEKISTAN, 148

V. 135 cotton, 310
Varietal trials: America, 53, 135; Tanganyika, 131, 307; Uganda, 222
Varieties of cotton: Brazil, 100, 136; Egypt, 108, 134; Gold Coast, 304; India, 43, 44, 216, 301; Italian Colonies, 138; Nigeria, 46, 47; Peru, 139; Russia, 155; Siam, 56; Tanganyika, 47, 131; Turkey, 56; Uganda, 207, 222; West Indies, 100
Verdao cotton, 106, 136
"Vernalization of Lyssenko's Method for the pre-Treatment of Seed" (Whyte and Hudson), 337
Verticillium albo-atrum. See *Verticillium wilt* under Diseases
Verticillium wilt. See Diseases
Verum cotton, 301; Verum Akola cotton, 44; Verum 262 cotton, 126; Verum 262 (Akola) cotton, 127; Verum 262 (Nagpur) cotton, 262; Verum (Early) cotton, 126; Verum (Late) cotton, 126
VIRGIN ISLANDS. See WEST INDIES
VIRGINIA. See AMERICA

Wagad cotton, 336; Wagad 8 cotton, 44
Wagale cotton, 93
"Water Requirements of Cotton on Sandy Loam Soils in Southern San Joaquin Valley" (Beckett and Dunshee), 322
"Weather and Cotton Yield" (Daingerfield), 228
"West African Agriculture" (Faulkner and Mackie), 162
Westex cotton, 66

WEST INDIES:
Bourbon cotton, 100; breeding experiments, 51; cotton cultivation, 133; diseases in, 50, 92, 93, 97, 99, 104; Empire Cotton Growing Corporation: assistance rendered by, 133, 308, 309; experiment stations, 51, 133, 309; ginneries, 50; Imperial College of Tropical Agriculture, 165, 223; "Loggerhead" cotton, 105; pests in, 50, 103, 104, 133, 237, 309, 327; rainfall in, 50, 51; research, 51, 133, 154, 309; Sea Island cotton industry, 308; varieties of cotton in, 100; West Indian Cotton Growers' Association, 133, 223, 308. *Anguilla*, 50. *Barbados*: Agr. Jour. of Dpt. of Sci. and Agr., 1932, 44, 217; cotton cultivation, 1931, 49; pests in, 50, 237; spacing experiments, 223. "*Leeward and Windward Islands*: Recent Agricultural Developments in" (Jones), 308. *Montserrat*, 44, 50, 98, 308. *St. Kitts-Nevis*, 44, 50, 223. *St. Lucia*, 44, 302. *St. Vincent*: Ann. Rpt. of Agr. Dpt., 1931, 44, 51; 1932, 302; cotton cultivation, 1931-32, 51; 1932-33, 51, 308, 309; cotton prospects, 133; Cotton Research Station, 51, 133, 309; diseases, 98, 104; legislation, 223; pests, 98, 133, 309. *Trinidad*: cane farming, 179; diseases, 97, 99; "Imperial College of Tropical Agriculture" (Aspinall), 165; Principal's Report, 1931-32, 223; "Memoirs of Cotton Research Station," 154, 242; "Notes on *Dysdercus*" (Pearson), 327; pests, 103. *Trinidad and Tobago*: Admin. Rpt. of Dir. of Agr., 1931, 128. *Virgin Islands*, 61
West Indian Cotton Growers' Association 133, 223, 308
Whitefly (*Bemisia gossypiperda*). See Pests
"Whither Lancashire? The Need for a New Outlook" (Gartside), 161
Willis cotton, 95
Wilt. See Diseases
Winesap cotton, 154
"World's Cotton Supplies. Why Empire Cotton is still needed" (Todd), 81 *et seq.*
"World's Textile Industry" (Niemeyer) 76, 341
"World Textile Industry: Is it at the Turning Point?" (Niemeyer), 76

Yarns. See Cotton Yarns
Yerli-Koza cotton, 249
Yoannovitch cotton, 108

Zagora cotton, 137, 138, 157
"Zaknihi: Its Objects and Attainments (Dzhevarlinsky), 71
"Zyklon B" disinfectant, 50

PRINTED IN GREAT BRITAIN BY
BILLING AND SONS LTD., GUILDFORD AND ESHER

I. A. R. I. 75.

INDIAN AGRICULTURAL RESEARCH
INSTITUTE LIBRARY,
NEW DELHI.

Date of issue.	Date of issue.	Date of issue.
2 Mi...		
...073		

MGIPC—S5—38 AR/54—7-7-54—7,000.